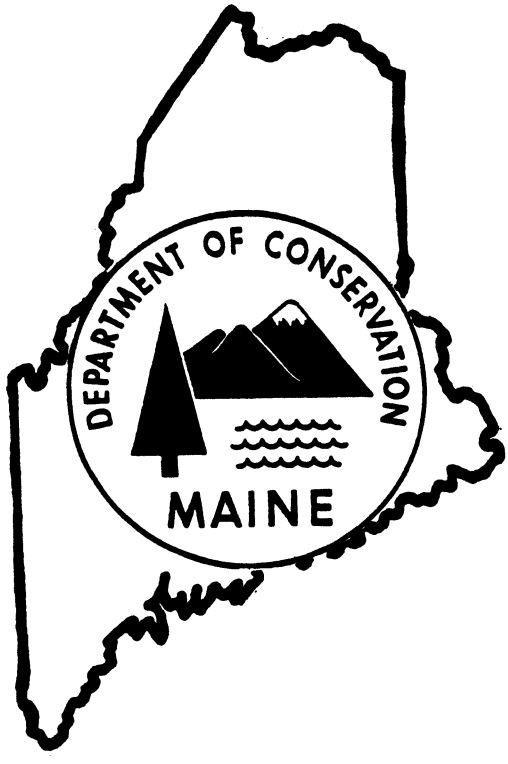
FOREST & SHADE TREE INSECT & DISEASE CONDITIONS

FOR MAINE

A Summary of the 1991 Situation



Insect & Disease Management Division
Summary Report No. 6
February 1992

Maine Forest Service
MAINE DEPARTMENT OF CONSERVATION
Augusta, Maine

MAINE

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Forest & Shade Tree Insect & Disease Conditions for Maine
A Summary of the 1991 Situation

C O N T E N T S

	Page
Acknowledgements	ii
Introduction	1
Highlights of Division Activities for 1991	1
Publications	1
Organization Chart (I&DM)	3
Operations Offices and Technician Districts (Map)	4
1991 Pest Summary	5
Light Trap Survey	5
Weather and Phenology	6
What's "New" and Unusual	6
Forest Pest Summary	6
Useful Suggestions	6
(A) Forest Pests - Softwoods	7
Insects	7
Diseases and Injuries	13
(B) Forest Pests - Hardwoods	16
Insects	16
Diseases and Injuries	22
(C) Plantation, Regeneration, Nursery and Christmas Tree Pests (Conifers Only)	24
Insects	24
Diseases and Miscellaneous Problems	27
(D) Shade Tree, Ornamental and Miscellaneous Pests	29
Insects and Ticks	29
Diseases and Miscellaneous Problems	36
Special Reports	
Forestry Related Quarantines in Maine	39
Gypsy Moth in Maine - 1991 by Richard Bradbury	41
White Pine Blister Rust Control Program - 1991 by Clark A. Granger	45
The Hemlock Looper in Maine - 1991 and a Forecast for 1992 by Henry Trial, Jr.	47

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Although this summary and our seasonal conditions reports are compiled and edited by **Richard Dearborn** and **Clark Granger**, there are many others who are essential in making these reports a success. We are again very grateful for the meticulous efforts and infinite patience of our secretary **Betty Barry** who manages to decipher the handwriting of a number of individuals and come up with something readable within a critical time frame. **Dot Arbour** maintains our mailing list and sees that we have the proper envelopes for our mailings so that she and Betty can speed our copies through the mailing process. **Dave Struble** not only serves as State Entomologist but also as proof reader for most reports which prevents us from sticking our proverbial feet in our mouths. **Richard Bradbury, Henry Trial, Jr., Don Ouellette** and **Dan Pratt** of our staff provide many items for inclusion in these reports as well as comments on others. Thanks also go to our excellent field staff: Supervisor: **Mike Devine** and Technicians: **Jody Connor, Skip Cram, Mike Skinner, Grayln Smith** and **Dave Stewart** who scour the state for information and records on the various insects and diseases. **Doug Stark** continues to be a faithful and reliable source of encouragement and support. And last but certainly not least are other department personnel and cooperators in the Maine Department of Agriculture, USDA-APHIS and the University of Maine at Orono. This is our team.

FOREST & SHADE TREE INSECT & DISEASE CONDITIONS FOR MAINE
A SUMMARY OF THE 1991 SITUATION

Introduction

The 100th anniversary of the Maine Forest Service in 1991 provided an opportunity to reflect on the history and direction of the various programs which have gone into making the Maine Forest Service a success. The I&DM Division (originally Insect Control and then Entomology Division) has comprised an important part of the State's overall forest protection program. We have seen our role change as the needs and approaches of forest resource managers have changed. This has been reflected in our name changes as well. As we enter our second century we see our role becoming even more challenging as we deal with increasingly critical forest health issues. Maine has been a leader in implementing programs to monitor and predict changes in the health of the forest resource. As we continue to adjust to changing demands we expect to see new roles continue to evolve.

As you read the following report you will see much of the same condition information we have included in our past reports. We hope that you will find this information useful to you both from a historical perspective and to plan your insect and disease management activities for the coming year.

Highlights of Division Activities for 1991

Forest health monitoring, gypsy moth and hemlock looper surveys, and various support activities were dominant features of the 1991 season for I&DM personnel. Much of the forest health monitoring effort was a part of the broader USFS coordinated program. Due to the elimination of all permanent seasonal staff positions in 1991, it became necessary to streamline division activities in order to effectively carry out intensive programs on major pests while continuing to survey other problems as well. Increased work loads were required to accomplish the necessary activity. We have again included in this report: a personnel listing (inside front cover), organizational chart (p. 3) and a map of field and lab operations, staff offices and districts (p. 4) for your use. Further streamlining and integration of activities will undoubtedly become necessary to more fully reflect forest health monitoring efforts. Any changes should not seriously jeopardize the gathering and reporting of forest pest conditions information, however.

Most of our activities are reflected in this report and we hope that this speaks well for our accomplishments.

Publications

The I&DM Division continues to maintain and upgrade a file of published reports, bulletins, brochures and information leaflets on programs and pests of importance to Maine's tree resources, both forest and urban. This file includes such publications as: Field Book of Destructive Forest Insects (Bull. 25, 1980); Insect Primer (Circ. 9, 1974 - now out of print) and The

Planting and Care of Shade Trees (Bull. 10, 1985). Through seasonal condition reports, readers are apprised of current pest developments, and the summary issues provide information which can be useful for planning purposes.

Throughout the year I&DM staff frequently contribute to items for the news media and various association newsletters. Articles which were written during the 1991 season covered a diversity of pests ranging from those affecting ornamentals to pests of sugar maple, shade trees, Christmas trees and small woodlots. Increasing dependence on I&DM staff expertise have spread use of the results of our activities throughout the northeast.

In addition to items already mentioned, the following new items have been published or completed (annual reports are for reference only and are not generally available for distribution) over the past year or are in the process of being published:

Insect & Disease Management Division. 1991. Annual Report for 1989. An unpublished internal report. 112 pp.

-------- 1991. Annual Report for 1990. An unpublished internal report. 149 pp.

-------- 1991 (February). Forest & Shade Tree-Insect & Disease Conditions for Maine - A Summary of the 1990 Situation. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Summary Rpt. No. 5. 61 pp. Compiled and edited by R.G. Dearborn and C. A. Granger.

-------- 1991. Forest & Shade Tree-Insect & Disease Conditions for Maine. 6 issues from April 23 through October 1. Compiled and edited by R.G. Dearborn and C.A. Granger.

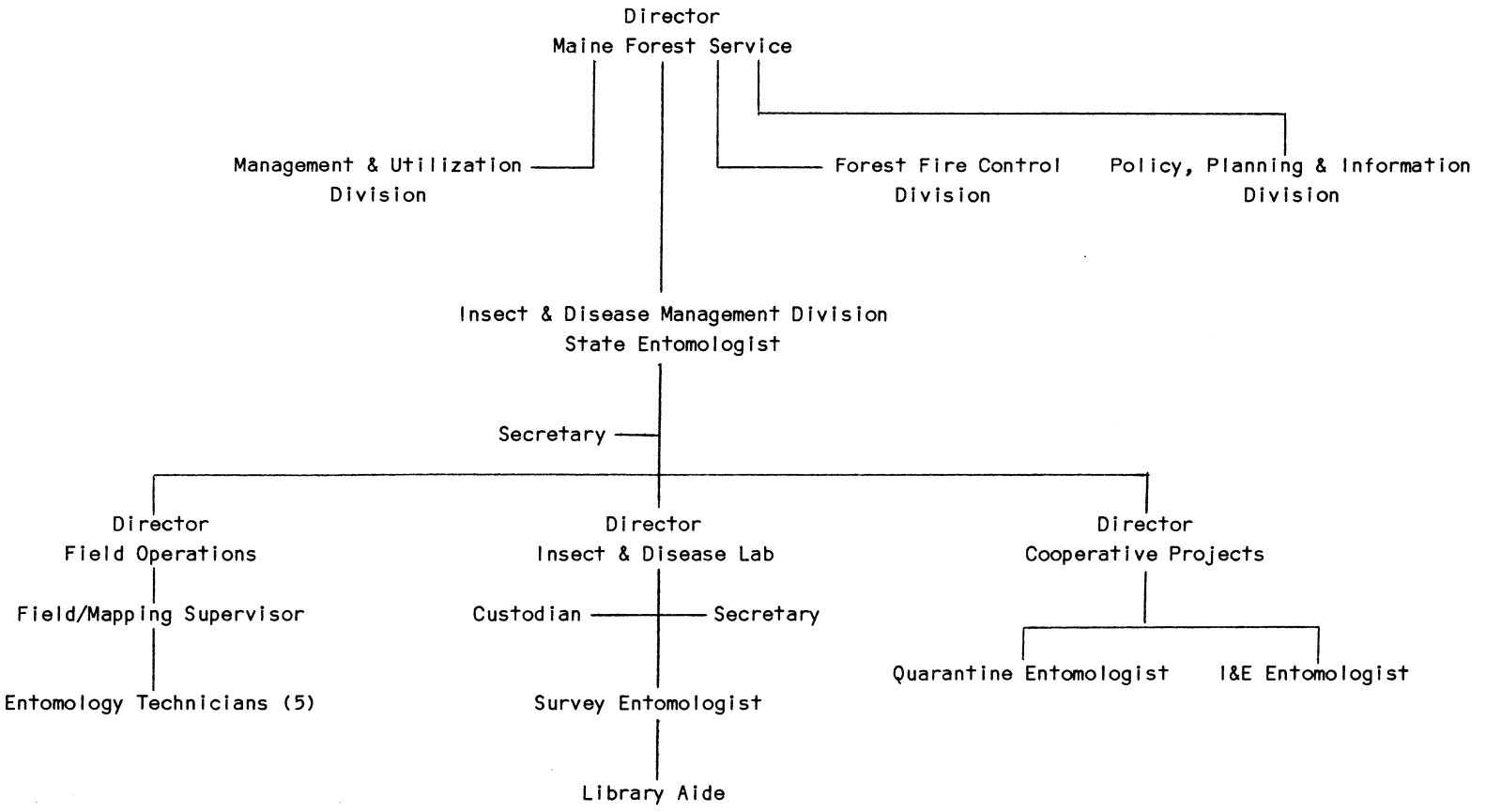
Trial, Henry, Jr. and Joan G. Trial. 1991 (February). The Distribution of Eastern Hemlock Looper [Lambdina fiscellaria fiscellaria (Gn.)] eggs on Eastern Hemlock [Tsuga canadensis (L.) Carr.] and Development of an Egg Sampling Method on Hemlock. Me. Dept. of Conserv., Me. For. Serv., I&DM Division. Tech. Rpt. No. 30. 12 pp.

Other publications/films which were published elsewhere but involve Maine situations that may interest our readers are:

Brooks, R.T., Margaret Miller-Weeks and W. Burkman. 1991 (May). Summary Report - Forest Health Monitoring-New England-1990. USDA-FS-NEFES. NE-INF-94-91. 9 pp.

USFS. 1991. Status Report-Forest Health Monitoring-Fiscal Year 1991. USDA-FS-NA-S&PF. 9 pp.

Vermont Dept. of Forests, Parks & Recreation. 1991. Are New England's Forests Healthy? A 28 minute VHS Video cassette film.



Maine Forest Service
MAINE DEPARTMENT OF CONSERVATION
Insect & Disease Management Division
Organizational Chart
February 1992

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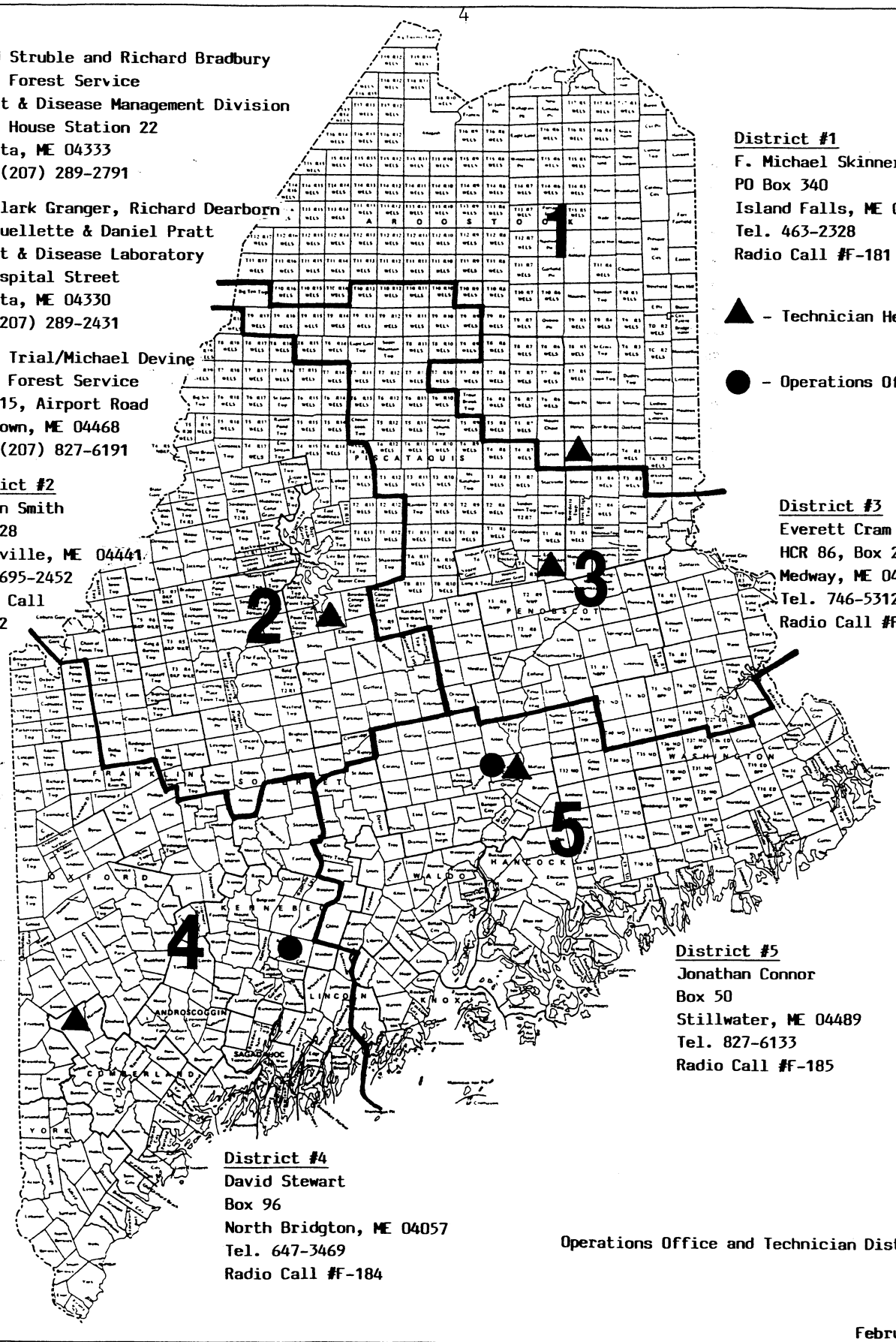

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Operations Office and Technician Districts

February 1992

1991
PEST SUMMARY

Maine's forest resources remain one of our most valuable and cherished assets and it is the responsibility of the Maine Department of Conservation to provide leadership and direction in their management and protection. For one hundred years, staff of the Maine Forest Service have been a visible and active presence throughout the State as they carried out this responsibility. Monitoring, reporting on and sometimes controlling insect and disease problems of forest trees have been a part of this responsibility. While some of the most obvious activities over the years have centered on control programs for such pests as white pine blister rust, spruce budworm and gypsy moth, a great deal of activity has involved often unseen but important continuous monitoring of forest health related problems. This more routine monitoring has provided the wealth of experience and information necessary to serve as an important foundation for reports such as this.

The following summary was composed from information gleaned from the full range of staff activities from special projects to routine surveys and surveillance as well as response from our constituents. While special projects such as those involving white pine blister rust, hemlock looper and gypsy moth have been visible to many observers, our staff has also been involved in many routine field activities to gather the extensive information and data which serves as the basis for extensive forest health related issues. One of the basic general surveys which have gone on behind the scenes for almost half a century has been our light trap survey for adult stages of many forest insects.

Light Trap Survey

A system of light traps was organized in 1943 as a means of detecting spruce budworm moth activity throughout the spruce-fir resource. This system of seven light traps was operated during the spruce budworm moth flight period (June 25 - July 25) in 1943 and 1944 at Ashland, Millinocket, Greenville, Eustis, Jackman, Cupsuptic and Princeton. Over the years much useful information was gained from these traps to expand our knowledge about adult spruce budworm moth activities. As the spruce budworm problem developed southward in the State and more information was needed for adults of other forest pest species the trapping program was expanded to cover more area and a greater time period. During the past year (1991) 23 traps were operated statewide (see Fig. 1). These traps are now operated in both hardwood and

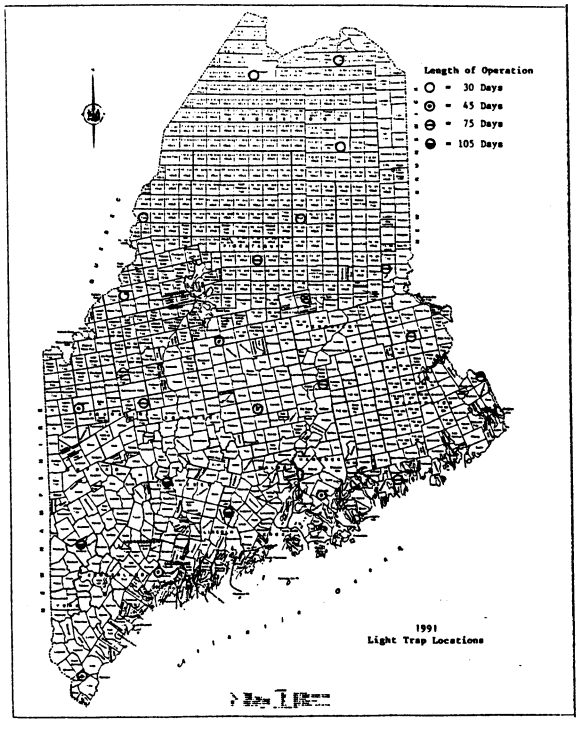


Figure 1

softwood areas and are targeted to monitor and quantify activities of specific pests such as the hemlock looper moths as well as large aspen tortrix, variable oakleaf caterpillar, saddled prominent and many others. Comparing activity from year to year will often provide an indication of a pending problem or problem area. Seasonal adult activity also provides valuable information to compare to other seasonal development data. This survey also provides a means of detecting new state or national records, tracking the spread of introduced species, and monitoring the activity of large flights of adult moths within the State, into the State or out of the State. We point this out so that when you see mention in this and future reports of adult moth activity, you will have a better appreciation of how this valuable basic survey procedure is used.

Weather and Phenology

The 1991 season will be known for its extremes of temperature, precipitation and wind. An early, hot, dry and windy spring resulted in early insect development. White pine weevil adults were up and moving by April 5 and they continued their activity well into June. Gypsy moth larvae began to hatch on April 29 and thousands of tiny larvae were blown around during a strong windy period on May 12. A short but severe freeze on May 19 and 20 caused noticeable, but apparently temporary, tree damage. This was again followed by hot dry weather especially in Aroostook County through late August. The weather related balsam twig aphid-host development anachronism caused some control problems as well. Following the advent of Hurricane "Bob" on August 19-20 the weather turned generally wet and cool for the remainder of the season. The fall and early winter were wet and cool but not excessively cold. A good solid ground freeze did not occur in 1991 in most areas of southern Maine and ice conditions on lakes and ponds were treacherous well into the winter season.

What's "New" and Unusual

Although our weather certainly brought the "new" and unusual, there was little else in this category in 1991 except for noticeable population changes or medical entomology related problems. These points are all discussed under Section D.

Forest Pest Summary

Hemlock looper and gypsy moth "led the pack" as far as insect pests were concerned and weather related impacts led as far as diseases and injuries were concerned. Many other pests also received our attention, some of which were serious and widespread in nature. Most of these are included in the following report.

Useful Suggestions

As in our last report the following summary and special reports section in this issue are rather lengthy. To avoid getting "bogged down" in items of little or only passing interest, the reader should proceed to the particular pest or section of pertinent interest and fill in with other sections or pests as time permits. You should use the **Table of Contents** to narrow your search in this selection process. For example, **Arborists** should find nearly

everything they need in Sections B (beginning on page 16) and D (beginning on page 29). **Christmas tree growers** should find items of interest in Section C (beginning on page 24). **Foresters** on the other hand might want to skim Sections A through C. All sections will include cross references to items of pertinent interest in other sections. **All readers** should refer to the special reports section for items of interest. Pages of all of the special reports are double numbered so that each one can be reprinted for distribution as a separate item.

We again hope you like this report and find it useful. Your suggestions for improvement are always welcome.

(A) Forest Pests - Softwoods
(See also Section C)

Insects

Aphids - Many species of aphids infest forest trees and although they may become locally a nuisance it is on Christmas trees and ornamentals that they stimulate most concern. See sections C & D.

Arborvitae Leafminer (a complex of 4 species) - Populations of arborvitae leafminer were generally low in 1991 except for local "hot spots" in central and eastern Maine. Trees which were previously heavily defoliated generally continued to recover. Mortality was evident on some sites, however, especially where other stress factors such as adverse weather and hemlock looper added to the impact. A total of twenty sites scattered throughout the resource (see Fig. 2) are surveyed for this pest each winter. The results are annually compared with the previous season to determine trends. The results for 1991 are summarized in Table 1 (pg. 8).

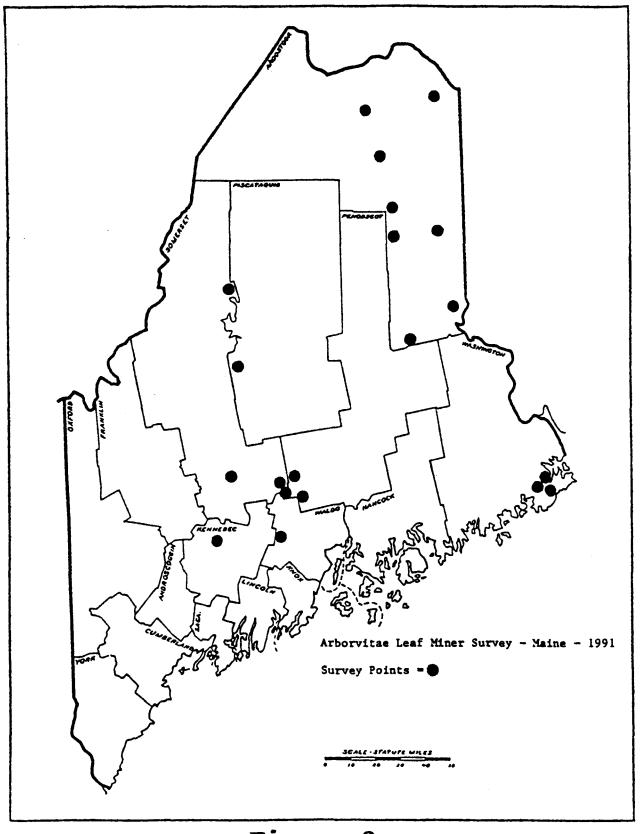


Figure 2

Balsam Fir Pests - For pests other than those listed in this section, see especially Section C and the Special Report Section on Hemlock Looper. The **hemlock looper** continues to be the most serious pest of balsam fir especially in eastern Maine while the **spruce budworm** (see discussion in this section) is now at barely detectable levels!

1991 Arborvitae Leaf Miner Summary

Location	# of Live Larvae Per 3" Twig-1991	# of Live Larvae Per 3" Twig-1990	Increase Decrease
Palmyra	0.48	2.65	-2.17
Belgrade	1.06	2.09	-1.03
Plymouth/Dixmont	1.00	2.39	-1.39
Cornville	1.27	3.25	-1.98
Newport	0.20	2.87	-2.67
Freedom	0.48	1.72	-1.24
Detroit	2.18	3.66	-1.48
Whiting	1.07	1.67	-0.60
Trescott	1.65	1.71	-0.06
Edmunds	1.08	2.41	-1.33
Ludlow	1.05	1.04	+0.01
Moro	0.60	0.96	-0.36
Nashville	0.28	0.25	+0.03
Connor	0.37	0.47	-0.10
T9-R5	0.22	0.17	+0.05
Winterville	0.42	0.45	-0.03
Orient	0.61	1.53	-0.92
Macwahoc	0.40	1.57	-1.17
Little Squaw	0.44	0.32	+0.12
Seboomook	0.13	0.05	+0.08

Table 1

Balsam Woolly Adelgid (Adelges piceae) - The gout phase of this pest continues to predominate in most areas especially coastal eastern Maine. Populations continued to decline in two areas, one each in central Penobscot and southern Piscataquis Counties, in which fir exhibited light to moderate trunk phase in 1989 and 1990.

Conifer Sawflies (various) - Defoliation by most species of conifer sawflies was light and remained spotty in 1991. Balsam tip boring, jack pine, larch and yellowheaded spruce sawflies, however, were among those causing limited damage in 1991.

Conifer Swift Moth (Korscheltellus gracilus) - Small developing larvae of this interesting "ghost" moth were fairly common in spruce duff in some stands checked in eastern Maine in 1991. These cream colored larvae with brownish heads will mature by mid season 1992 when they will pupate. Moths of another generation will emerge in August. This species has a two year life cycle.

Eastern Larch (Bark) Beetle (Dendroctonus simplex) - New attacks were not common in 1991 in areas previously infested indicating that the problem may have stabilized there. Very small and localized new outbreaks did, however, appear in 1991 in southern Hancock and Washington Counties. Infestations were most evident on coastal peninsulas and offshore islands from Mount Desert Island east.

Annual mortality rates appear to be lessening in all but eastern Maine where new attacks indicate a possible buildup of the problem in 1992 which is likely to continue into future seasons. Accumulated mortality is, however, still common and very noticeable in many larch stands throughout southern, central and northern Maine. Losses cannot easily be determined but they are extensive in some older stands where up to 100% of the stems have been killed in 10-25 acre patches. Some ornamental larch have also been killed in areas near infested wild stands.

Hemlock Loopers (Lambdina spp.) - Two species of the genus Lambdina infest hemlock in Maine. In the larval stage they are for all practical purposes identical. But in the adult stage and in certain biological habits they differ significantly. Because it is necessary to know which species is present for assessment purposes, a collection containing larvae of both species can be confusing.

Lambdina fiscellaria - This is the more common hemlock looper in Maine, especially to the north and east. Populations are heaviest in eastern portions of Maine and many conifers, especially fir and hemlock are attacked. Moths emerge in September. Defoliation is heaviest in early stages of an outbreak toward the interior of the tree and on lower branches. See Special Reports Section for more details on our current outbreak of this species.

Lambdina athasaria - This species appears to be more common in southern and western Maine. Defoliation is primarily on hemlock. Moths emerge in the spring. Defoliation appears to be concentrated at the tops of the trees and more tips show signs of early feeding.

L. athasaria caused significant defoliation in 1989 and to a lesser extent, 1990 in the Sebago Lake (Cumberland County) area and along with L. fiscellaria on coastal peninsulas from Waldoboro to Brunswick (Lincoln and Sagadahoc Counties). Although 10,000 acres were surveyed in 1991 in Cumberland County and 1,500 in Lincoln and Sagadahoc Counties, populations were found only in Cumberland County. Current defoliation definitely attributable to L. athasaria was none to light in areas checked.

Hemlock Problems - Hemlock continues to "show signs of wear" from a variety of problems, the more notable of which is the **hemlock looper** (see Special Reports Section). **Hemlock needle miners** continue to be locally

noticeable while populations of the **hemlock looper,** Lambdina athasaria have diminished considerably (see discussion preceding). Hemlock mortality is quite variable and surprisingly difficult to predict in many cases. Where stress is followed by the **hemlock borer** (Melanophila fulvoguttata) or **shoestring root rot** (caused by Armillaria spp.), mortality is assured and often striking. In other situations hemlock appear to have recovered even where defoliation was moderate to severe. Weather and infection rates by pathogenic fungi apparently have a significant role in many cases.

Hemlock Woolly Adelgid (Adelges tsugae) - Although there appears to be some expansion of this problem into new areas in Massachusetts, recent cold hardiness studies indicate that survival of the pest would be greatly limited by the colder climate found in many areas of Maine. In order to detect any possible introduction of the adelgid into Maine, the Maine Forest Service and the Maine Department of Agriculture maintain and monitor a joint quarantine on importation of hemlock products from infested areas (see Special Report section).

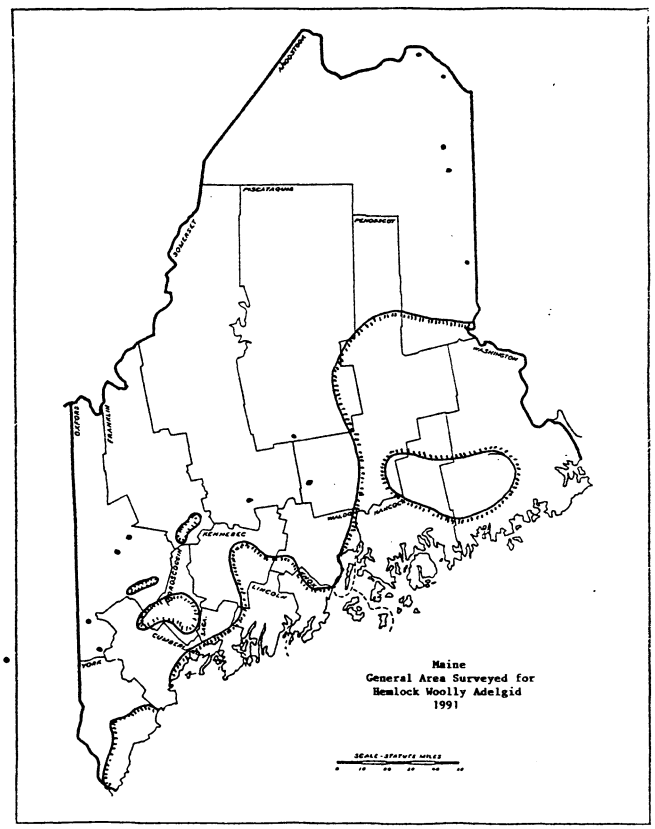


Figure 3

Survey methods for the adelgid involve on-ground inspection of three or more hemlocks at individual locations. These locations include (see Fig. 3):

- Forest stands in conjunction with hemlock looper surveys
- Roadside hemlocks at picnic and rest areas in southern and central Maine
- Specific checks of ornamental hemlocks throughout Maine

Jack Pine Sawfly (Neodiprion pratti banksianae) - Populations of this species remained active on mature jack pine in coastal areas of Hancock and Washington Counties from Steuben to Mt. Desert. Defoliation was very local but ranged from light to moderate in many infested stands. Stands checked during the fall of 1991 showed high numbers of eggs deposited within the needles. See also **northern pitch twig moth.**

Larch Casebearer (Coleophora laricella) - Stands of larch "scorched" by the feeding of this species were very obvious throughout much of the southern half of Maine in late May and June of 1991. Damage appeared to be the most extensive thus far in the present outbreak which is now in its fourth consecutive year.

Larch Sawfly (Pristiphora erichsonii) - Moderate defoliation of large, nearly mature, European larch over two acres in a plantation in Atkinson was brought to our attention in early September. This was our only reported defoliation by this pest in 1991 and is the first significant amount of larch sawfly defoliation we have seen in several years.

Mites - See Section C.

Northeastern (Pine) Sawyer (Monochamus notatus) - The adult, longhorned beetle stage of this insect was extremely common this season in several areas where eastern white pine had been stressed by white pine blister rust, lightning or construction. Approximately 40-50 of the large, grayish beetles could be seen moving about the lower boles of several very large living white pine in one area in Augusta in late August. Lightning stressed trees appear to really draw the adults. The larval roundheaded borer stage can kill trees in such situations.

Northern Pitch Twig Moth (Petrova = Retinia albicapitana) - "Gobs" of pitch containing larvae or pupae of this species are very common and unsightly on twigs and branches of jack pine especially in Hancock and Washington Counties. Most of these pitch masses are at the base of small branches or around buds. Damage by this insect is usually limited to minor twig and branch mortality and the unsightly pitch masses. This species has a two year life cycle.

Pine Fascicle Mite (Trisetacus alborum) - Populations of this species appeared to be down in 1991 and damage was barely detectable in most cases.

Pine Leaf Adelgid (Pineus pinifoliae) - The cone-like galls of this species were easily noticeable on red and black spruce in eastern and central Maine in 1991. Although no population surveys were conducted in order to determine the potential impact of this adelgid to adjacent white pine, damage is expected to be generally light.

Pine Tip Boring Bark Beetles - A number of different bark beetles tunnel in the tips of various pines causing visible flagging. In most cases damage is aesthetic. This phenomenon appeared to be more common than usual in 1991. On white pine the damage is caused by Pityophthorus spp. On red pine the damage is sometimes caused by Pityophthorus sp. but is more commonly caused by the red pine cone beetle Conophthorus resinosae). The red pine cone beetle can also cause serious losses of seed cones in seed orchards.

Spruce Beetle (Dendroctonus rufipennis) - New attacks on large white and red spruce by spruce beetle in known infested stands or in new areas were very rare in 1991. This lack of new attack in 1991 following a low rate of attack in 1990, probably signals the end of the recent outbreak in northern and western Maine. It is possible however, that the lack of new attack is simply a lull in the outbreak which could be followed by a resurgence of activity in the near future. Quiet periods in the outbreak did occur in several areas in the late 80's. Since many high risk trees in large infested areas remain unattacked, however, we feel the outbreak is most likely over.

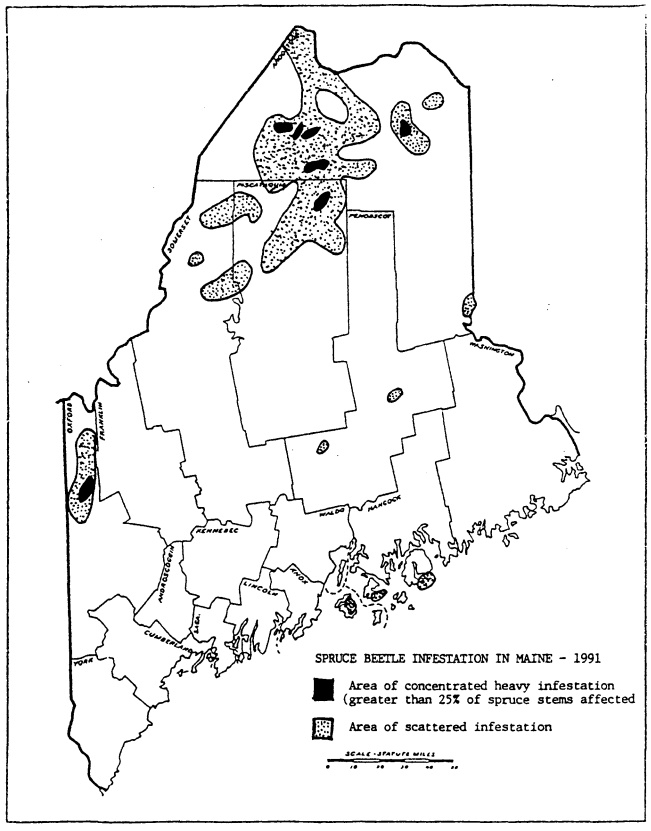

SPRUCE BEETLE INFESTATION IN MAINE - 1991
Area of concentrated heavy infestation (greater than 25% of spruce stems affected
Area of scattered infestation

Figure 4

Several new, small areas of beetle activity were found on islands in Hancock County. Most of these areas consisted of only a few trees and many of the trees were attacked in 1990 or previous to that. Relatively few new attacks were found. Because so few trees were involved and because most of these islands are not easily accessible for ground survey, the activity was not detected until 1991 when aerial and ground surveys were intensified for hemlock looper. The total area affected by looper on these islands was estimated at 50 acres.

The lack of new beetle attack means that the overall impact of the outbreak remains about the same as reported in 1990. Addition of the coastal areas brings the total acreage where 25% or more of the available host was attacked to 9,050 acres (see Figure 4). Salvage of the largest of the affected areas has been aggressive and is nearly complete.

Spruce Budworm (Choristoneura fumiferana) - The spruce budworm is now at endemic levels statewide. No defoliation was detected during aerial or ground surveys of Maine spruce-fir forests in 1991. Surveys for larvae at twenty traditional budworm survey locations throughout the northern half of Maine, as well as the general forest insect survey, produced no budworm larvae. A single sixth instar larva was found in a hemlock looper larval sample taken in Lee.

The 23 light traps (see Fig. 1) operated throughout the state during the budworm moth flight period caught an average of less than one moth per trap. Sixteen traps caught no moths and the highest seasonal catch was only 8 moths (at the Steuben location). A total of only 21 moths was caught in 23 traps. This is the lowest catch since the mid 40's.

Another measure of low level budworm population density, pheromone trapping, was not used in Maine in 1991 due to other more pressing needs for Division resources. However, pheromone trapping is considered a useful means, along with light traps, of detecting the inevitable resurgence of budworm. Pheromone trap catches in western Quebec and Vermont indicate increased budworm activity in these areas but, a return of budworm populations to damaging levels is not expected in Maine in the near future. A resumption of pheromone trapping is planned in Maine in 1992.

Spruce Pests - See Section C for problems other than those which are listed in this section. **Hemlock looper, spruce beetle** and **spruce budmoth** were among the more serious pests of spruce reported during 1991.

White Pine Weevil - The white pine weevil is a pest of white pine and other conifers in many situations. For the purposes of management and control, however, it is generally considered a plantation problem. For this reason our discussion of this species can be found in Section C.

(A) Forest Pests - Softwoods

Diseases and Injuries

Armillaria Root Rot (caused by Armillaria spp.) (See also Section D) - This disease, known also as shoestring root rot, is caused by an opportunistic fungus which may attack and kill hardwood and softwood trees of all ages. Where softwoods are infected, the disease organism involved is usually A. ostoyae. This organism frequently infects balsam fir, black spruce, and red spruce in Maine, and is a contributing factor to the "sudden death" of balsam fir known as Stillwell's Syndrome (see below). The causal fungus is widely distributed in nature and disease management in natural stands is best approached by keeping trees vigorous. Dense stands should be thinned frequently, beginning early in the rotation.

Disease expression, although widespread, seemed to remain at normal levels during 1991.

Balsam Fir Needle Rusts - See Section C.

Eastern Dwarf Mistletoe (Arceuthobium pusillum) - No new infestations of this parasitic plant were reported in 1991. Severe damage is still occurring in stands of white spruce in coastal areas. Trees of landscape value succumb each year in the yards of coastal residences as this parasite gradually drains trees of their vigor. Removal of witches' brooms (infected portions of branches), together with appropriate fertilization, generally helps to maintain the vigor of affected landscape trees.

Dwarf mistletoe also frequently occurs on black spruce, particularly in bogs, and on red spruce in forest stands. Brooms on red spruce are often more poorly developed than on white or black spruce and may be overlooked. However infected residual trees left during timber harvesting activity can result in the infection of spruce regeneration. Infected trees should therefore be removed during the harvesting operation.

European Larch Canker (caused by Lachnellula willkommii) - Surveys were conducted in selected coastal towns in 1991 to determine whether this disease may have spread from previously known infected areas. Surveys in Lamoine, Wiscasset, and Sullivan proved negative and the acreage known to be infested remains at 6,500. Inspections of two paper industry larch seed orchards (Unity and Howland) also proved to be negative. Additional selected surveys are planned for 1992 in towns adjacent to other known infested areas to help assure that existing quarantine boundaries are still appropriate.

In order for wood processing mills located outside infested areas to receive larch products harvested from within infested areas, compliance agreements with MFS are required. These agreements seek to assure that incoming infested products are either utilized at the receiving mill site or shipped to and destroyed at other sites which are also under compliance agreements. The primary product likely to be shipped from a compliance mill to another compliance site is bark to be burned for electric power generation. Since incineration destroys the causal organism, there is no further risk of spread. If the bark from infected trees were to be used for ornamental purposes (i.e. mulch), however, larch canker could conceivably spread to new areas. MFS staff regularly inspects sites under compliance agreements to assure that the conditions of those agreements are being met, and negotiates any new agreements necessary to assure a smooth flow of product. In 1991 mill sites in Jay, Rumford, Skowhegan and Woodland were inspected and found to be in compliance, as were power generation sites in Stratton and Athens. (See also quarantine information in the Special Reports section).

Herbicide Injury - The herbicide Tordon RTU which is useful for controlling unwanted trees via cut surface treatments, was apparently responsible for injuring nearby white pine reproduction on a woodlot in Waterboro. The landowner had sprayed freshly cut oak and birch stumps with Tordon on numerous occasions over the past several years. While control of stump sprouting was excellent, nearby pines were definitely affected. It was not possible to determine whether the damage observed was due to the effect of spray drift, or to root uptake, or both. Some affected trees were dead but most, although symptomatic, had green buds which seemed viable. A few trees were found which had been affected by spraying in previous years, but they had recently outgrown symptoms and were now growing normally.

Glyphosate (Roundup) caused minor damage to balsam fir reproduction when sprayed aerially for conifer release in West Forks Plantation. Spray had been applied in August 1990 but injury was not apparent until shoots flushed during the spring and summer of 1991. This effect is not uncommon when spraying for conifer release and is not considered serious. Glyphosate injury was more acute on Colorado blue spruce nursery stock in a plantation in Belgrade last season. Again the result of fall 1990 spray application, new shoots of the blue spruce affected by glyphosate were typically smaller and paler in color than normal shoots. These trees too will recover but will not be suitable for sale for another year.

Lichens - Lichens growing on dead and dying conifers are frequently and falsely accused of having a role in tree decline and death. We had several reports in 1991 from landowners concerned about lichens, particularly in northwestern Maine.

Lichens certainly look as though they ought to be parasitic and many people have a hard time believing that they are not. While they do grow profusely on declining and dead trees, those trees are almost certainly dying for other reasons.

Lichens are comprised of fungi and algae growing symbiotically. Since the algal component is a green plant, light is required for growth. Lichens grow more rapidly when exposed to full light, which explains their profusion on dead trees.

Pinewood Nematode (Bursaphelenchus xylophilus) - To date we have found this nematode infesting only three conifer species in Maine: balsam fir, white pine, and red pine. It is potentially present in the wood of certain other coniferous hosts as well.

Although pinewood nematode (PWN) was not discovered in the United States until 1929, it is considered to be a native, not introduced, pest. There is no indication that PWN has ever caused large scale mortality of conifers in Maine or elsewhere in North America (NA). However, PWN is the number one pest of conifers in Japan, where it may have been introduced from NA in the late 1800's.

PWN is primarily significant here because its presence has the potential to seriously affect export markets. Quarantines barring import of coniferous wood from NA have already been implemented by certain Scandinavian countries, and concern is being expressed in other European markets as well.

This year a manufacturer in the Netherlands expressed concern with the importation of non-kiln-dried hemlock from Maine. There are apparently no records of PWN infesting hemlock, and recently an intensive search for evidence that PWN infests hemlock wood in New Brunswick and Nova Scotia was negative. While kiln drying apparently will kill PWN, this organism will probably limit export markets for non-kiln-dried lumber for some time to come.

Sirococcus Shoot Blight (caused by Sirococcus conigenus - See also Section D) - Although this disease seems to have been increasing in recent years, we only had one specimen submitted for diagnosis in 1991. The landowner who submitted the sample was concerned with maintaining an understory of red pine in an area of infected overstory pine. Most understory pine was already infected, and with inoculum expected to continually "rain" down from above, we recommended against attempting to artificially regenerate this species in the understory.

Stillwell's Syndrome or "Red Fir" (associated with Armillaria spp.) - In northern and central Maine the incidence of "red fir" has gradually decreased since the mid 1980's. The level in 1991 remained at less than 1% of the balsam fir affected, roughly the same as 1990.

Losses to Stillwell's syndrome continue to be in the form of individual stems in and near areas heavily damaged by past spruce budworm feeding. After the needles drop from affected trees, mortality from Stillwell's cannot be differentiated from budworm mortality. This disorder will probably continue to kill a significant number of fir stems in southeastern Maine for 2 to 4 years but, its significance is much reduced in northern and central Maine. In the future it is possible that Stillwell's Syndrome may affect fir which have been heavily defoliated by hemlock looper.

White Pine Blister Rust (caused by Cronartium ribicola) - We continue to operate a white pine blister rust control program to manage this disease in the state's important commercial white pine production areas (see Special Reports Section). A quarantine remains in force which prohibits the planting and cultivation of currants and gooseberries (alternate hosts for the disease organism) within the blister rust control area (southwestern and central Maine). The planting of black currants is prohibited statewide because this particular currant species is an especially potent disseminator of the disease organism (see also Forestry Related Quarantines in Special Reports section).

Wind Damage - See Sections B, C, and D.

Winter Injury - See Sections C and D.

(B) Forest Pests - Hardwoods (See also Section D)

Insects

Alder Flea Beetle - See Section D.

Aphids (various) - Although present in varying degrees on different hardwoods statewide in 1991, aphids continued to be primarily a nuisance. In concert with other sucking insects such as treehoppers, leafhoppers and scales these little sweet "factories" produced an excess of honeydew which often coated objects and vehicles parked beneath infested trees, especially red oak. Ants and various stinging insects and flies, which were then attracted to these deposits, became the primary problem. Black sooty mold fungus often "grew" over residues which were not washed off.

Balsam Poplar Leafminer (?Lyonetia sp.) - Populations of and damage from feeding by this species continued to decline in 1991 for the second consecutive year. No new areas of infestation were found and reddening of trees was much less visible than it has been.

Beech Problems (various) - Beech stands continue to hang on in spite of a continued "onslaught" of problems ranging from insects and diseases to a severe freeze. Although beech stands across eastern and central Maine were heavily defoliated as a result of a severe spring freeze on May 19-20 (see Diseases and Injuries section which follows) current damage from

late season defoliators was down. **Variable oakleaf caterpillars** were still in evidence in some stands but down from 1990 levels while **oystershell scale** (Lepidosaphes ulmi) was harder to find and very local. **Saddled prominent** larvae were not found in any stands which were checked.

Birch Casebearer (Coleophora serratella) - Populations of birch casebearer were higher than expected in central and east coastal Maine in 1991 but still caused only light to moderate defoliation. Where these populations coexisted with **birch leafminer**, damage was the heaviest. The problem in the Rangeley area appeared to be relatively stable at low levels. Areas in Aroostook County which had noticeable defoliation in 1990 were not surveyed.

Birch Leafminer (primarily Messa nana) - Although 1991 population levels were similar to those experienced in 1990, some range extension of moderate to heavy defoliation was noted toward the east especially in southern Washington and Hancock Counties (see Fig. 5). Populations were locally high on white birch and white birch hybrids elsewhere as well including a continuous monitoring site in Dixmont. Numbers of and damage from the **early gray birch leafminer** (Fenusa pusilla) were low again in 1991.

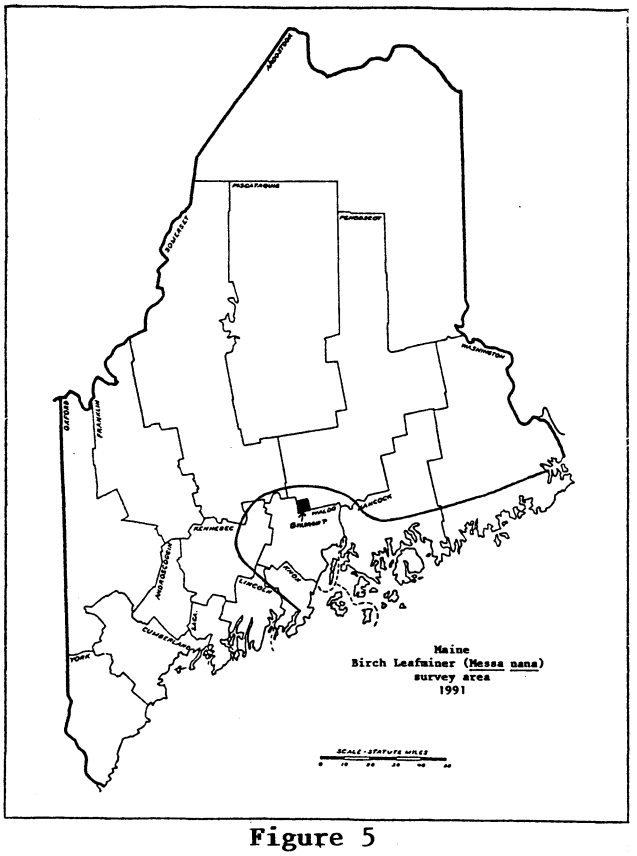


Figure 5

Birch Problems (various) - The major insect problems affecting birch this season other than those listed here were **fall webworm, gypsy moth** and **Japanese beetle** which caused locally significant defoliation in southern Maine. Populations of larvae of the **spearmarked black moth** (Rheumaptera hastata) were reduced to endemic levels. **Lacebugs** (Corythuca spp.) continued to cause noticeable mottling and yellowing of some trees. This was especially noticeable in some ornamental settings. **Bronze birch borer** damage continues to show up throughout the birch resource especially where stress factors have pushed birch to the "brink." Other problems were isolated cases or very minor in impact.

The **luna moth** (Actias luna) and the **polyphemus moth** (Antheraea polyphemus) were again abundant in some areas which was good to see.

Birch Sawfly (Arge pectoralis) - Populations of this forest pest dropped further in 1991 causing only light to moderate defoliation on individual trees in west-central Penobscot County.

Birch Skeletonizer (Bucculatrix canadensisella) - This was one of our surprises in 1991 and caused late season browning of white birch over roughly 10,000 acres in mountainous areas south of Rangeley from Grafton to Phillips. Scattered larvae were also visible on white birch at other localities throughout central and eastern Maine. Late season browning of white birch reported from northern Maine may also have been caused by larvae of this species.

The birch skeletonizer has caused periodic late season defoliation of white birch over much of northern and central Maine in the past but has been more or less absent for a number of years. Defoliation by this species occurs late enough to be confused with normal foliage color changes in some seasons. The impact of late season defoliators such as this to the host is generally considered minor.

Browntail Moth - See Section D.

Cankerworms and Loopers - The spring feeders: **Bruce spanworm** (Operophtera bruceata), **spring cankerworm** (Paleacrita vernata) and **fall cankerworm** (Alsophila pometaria) were again very low in numbers in 1991 with no defoliation detected. See also hunter's moths in Section D.

Eastern Tent Caterpillar - See Section D.

Fall Webworm (Hyphantria cunea) - Locally high populations and heavy feeding and webbing by this species on a wide variety of deciduous hosts were evident again in 1991 for the fourth consecutive year. Although this remains a nuisance pest in most cases, some evidence of more permanent host damage and suspected mortality has been reported.

Flat Leaftiers (Psilocorsis spp.) - Larvae of these defoliators occur most commonly on beech in Maine although other hardwoods are also infested. Populations were noticeable in 1991 but generally caused only light to moderate damage.

Forest Tent Caterpillar (Malacosoma disstria) - Although populations of this pest continue to increase to our west in Canada, no noticeable defoliation of woodland poplars by this species occurred in Maine in 1991. Scattered reports of larval activity (low numbers) were however reported in 1991 from northern Maine. These were the first such reports in a number of years.

The last outbreak of this species occurred in northern and western Maine in 1979-1983.

Greenstriped Mapleworm (Dryocampa rubicunda) - Populations of this species remained extremely low in 1991 with no noticeable defoliation reported. This species is primarily a feeder on red maple in Maine.

Gypsy Moth - See Special Reports Section and also **rash** writeup in **medical entomology** Section D.

Hemlock Looper - (Lambdina fiscellaria) - Damage to hardwoods by this species was again minimal in 1991 except in areas of the heaviest softwood defoliation. In such situations some feeding on hardwoods did occur especially on birch. See special reports section.

Japanese Beetle - See Section D.

Large Aspen Tortrix (Choristoneura conflictana) - Defoliation of aspen by larvae of this species declined in extent and severity in most areas in 1991 from 1990 levels. There were, however, reports of several hundred acres of aspen defoliated by this species in Pierce Pond and Bigelow townships (central Somerset County). Populations in the Jackman area, where defoliation was heavy in 1990, were down dramatically and only extremely light feeding damage was apparent in 1991.

Locust Leafminer - See Section D

Maple Leafroller (Sparganothis acerivorana) - Red maple south and east of Ellsworth, which were noticeably defoliated by this species from 1988 to 1990, showed little evidence of feeding activity in 1991. Scattered individual trees and trees in small pockets in some areas did, however, exhibit higher populations but little damage.

Maple Spanworm (Ennomos magnaria) - The attractive, spotted, orange-yellow medium-sized adult moths of this large looper were again commonly seen in 1991. These moths, which are also called **notched-wing geometers**, appear in September and October and are one of the larger, more noticeable moths which are attracted to light at that time. Only scattered larvae were found throughout the season and no defoliation was observed. Larvae feed on birch, maple, aspen, ash and a variety of other hardwoods.

Maple Trumpet Skeletonizer (Epinotia aceriella) - Reports of this species were down in 1991 from 1990.

Oak Leaf Shot-Hole (caused by Japanagromyza viridula) - "Ratty," shot-hole riddled red oak foliage was a common sight in many areas early in 1991 as a result of ovipositor induced injury by this small fly. Larval mining was, however, very light. Locally heavy damage in which the foliage was strikingly riddled, twisted and otherwise distorted was common over a wide area from Mt. Desert Island to Blue Hill and in and around Farmington. Several thousand acres were affected. Damage was the highest seen in years. Much of the affected foliage had been at least "nipped" by frost which made the effect even more striking.

Oak Leaftier (Shredder) (Croesia semipurpurana) - Populations of this species remained very low in 1991 and only small hot spots of noticeable defoliation were reported.

Oak Skeletonizer (Bucculatrix ainsliella) - It was difficult to find larvae or signs of feeding by this species in 1991 even in areas previously defoliated.

Oak Twig Pruner (Elaphidionoides villosus) - Populations of the oak twig pruner remained fairly stable at low levels for the sixth consecutive year. Damage to individual trees, however, was occasionally heavy.

Obliquebanded Leafroller (Choristoneura rosaceana) - Populations of this versatile feeder on a wide variety of deciduous hosts remained low in 1991. No defoliation was observed.

Orangehumped Mapleworm (Symmerista leucitys) - It was difficult to find larvae of this species in most areas in 1991 and even more difficult to find signs of feeding damage. Light trap collections of moths of this and related species (Symmerista spp.) were also down for the second consecutive season in 1991 (see Table 2).

Oystershell Scale (Lepidosaphes ulmi) - Populations of this scale on beech remained more or less endemic in 1991. Beech mortality, however, rose strikingly across central and eastern Maine in 1991 following the severe May 19-20 freeze (see following section). It was felt that this increased mortality was due in part at least to stress resulting from oystershell scale feeding, beech scale/nectria, hardwood defoliator feeding and drought.

Pear Thrips (Taeniothrips inconsequens) - Pear thrip populations remained fairly stable at low levels in 1991 although light feeding damage was observed in Mount Vernon and Carroll. No soil surveys were conducted by I&DM in 1991. Visual checks of sugar maple stands were made, however, in all but northern Maine.

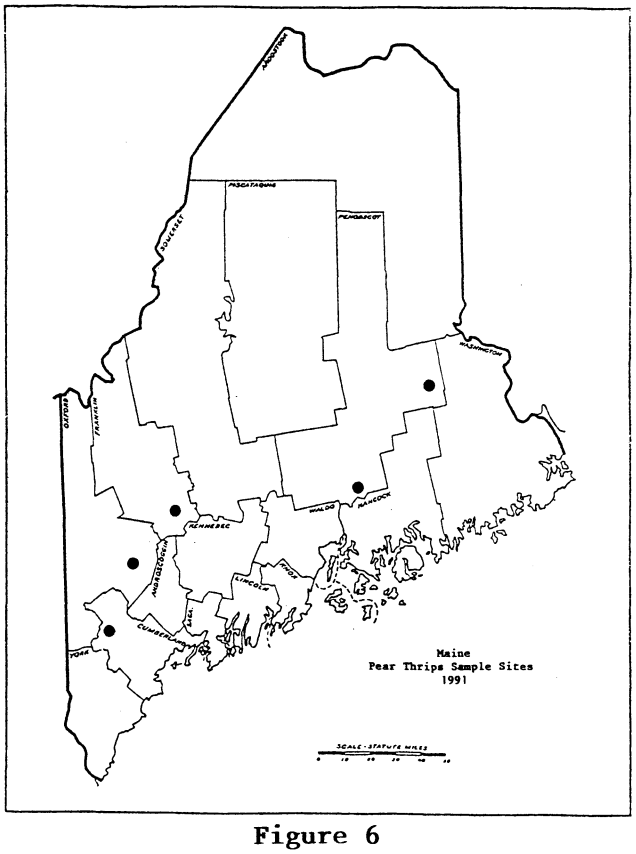


Figure 6

The Maine Cooperative Extension Service through the Pest Management Office in Orono did participate in the USDA-APHIS Pear Thrips Multistate Project. This survey utilized yellow unscented sticky traps at five sites (see Fig. 6) to monitor spring emergence. Emergence began during the period of April 5-11 at West Paris, Farmington and Baldwin. The total number of thrips caught at these five sites was generally low except for one high activity period (May 5-10) at Carroll (262 thrips). The total number of thrips caught at these five sites were: West Paris (45), Dedham (26), Carroll (280), Farmington (57) and Baldwin (19).

Saddled Prominent (Heterocampa guttivitta) - Only scattered individual larvae of this and related species of Heterocampa were again reported in 1991 and no defoliation was observed.

A trapping program using pheromone lures was conducted in 1991 by I&DM in cooperation with the USFS. Traps were placed at three sites (included are total number of moths caught): Exeter (7), Washington (8) and Mt. Vernon (7).

Satin Moth (Leucoma salicis) - This species continued to maintain a low profile in 1991 and defoliation of woodland poplar was light and limited to small pockets in coastal Washington and Hancock Counties and southwest of Millinocket in central Maine.

Tussocks and Dagger Moths (various) - Populations of these "fuzzy" caterpillars were the lowest in 1991 that they have been for several years. No defoliation was reported. The most common species reported was the yellow and black **spotted tussock** (Lophocampa maculata).

Variable Oakleaf Caterpillar (Lochmaeus manteo) - Populations of the variable oakleaf caterpillar continued their slide downward in 1991 reaching almost endemic levels in many areas. At the same time, however, it is interesting to note that moth catches remained high or even increased across central Maine (see Fig. 1 and Table 2).

Where defoliation was observed it was limited to trace to light except on isolated individual trees where defoliation was moderate to heavy. Stress related mortality of beech in areas previously heavily defoliated by this species may be in part a result of feeding by this species in the late 1980's (see also Beech Problems and Frost Injury).

Light Trap Collections
Annual Comparison by Species
(Seasonal Totals)

	Symmerista spp. Year						Lochmaeus manteo Year					
Location	86	87	88	89	90	91	86	87	88	89	90	91
Allagash	0	0	0	0	0	0	0	0	0	0	0	1
Ashland	0	0	1	0	0	0	0	0	0	0	7	10
Blue Hill	14	0	2	2	0	0	0	0	0	0	7	4
Brunswick	81	0	81	31	4	8	0	0	3	80	4	2
Calais	-	-	-	-	5	1	-	-	-	-	2	4
Chesuncook	-	-	-	-	1	0	-	-	-	-	0	1
Dennistown	0	0	1	0	0	1	0	0	3	2	7	7
Elliotsville	51	0	285	155	44	10	16	12	19	37	87	175
Exeter	-	-	-	20	0	1	-	-	-	40	9	7
Greenbush	6	0	50	70	3	0	1	1	12	56	49	39
Guerette	-	0	0	0	0	0	-	0	0	1	2	1
Haynesville	-	-	-	12	1	0	-	-	-	15	94	86
Kingfield	11	0	8	11	0	0	3	16	49	70	192	158
Matagamon	9	0	2	7	2	0	0	0	0	10	17	13
Millinocket	3	0	342	211	9	0	0	1	51	276	169	310
Mt. Vernon	18	0	28	28	3	2	0	0	10	9	0	2
No. Bridgton	4	0	35	14	3	10	0	0	0	4	5	6
Rangeley	-	-	-	0	0	1	-	-	-	1	5	3
So. Berwick	81	0	45	32	18	13	0	14	16	14	11	15
St. Aurelie	1	0	0	0	0	0	0	0	0	1	0	0
Steuben	-	-	-	6	0	7	-	-	-	8	3	3
Topsfield	46	0	72	362	67	5	3	1	27	114	316	302
Washington	77	0	25	20	3	6	4	21	54	21	23	2
Totals	402	1	988	1002	163	65	27	66	247	768	1009	1151
Total Traps	17	17	17	21	23	23	17	17	17	21	23	23

Table 2

(B) Forest Pests - Hardwoods

Diseases and Injuries

Ash Dieback (cause unknown) - The brown ash (Fraxinus nigra) dieback we first noted in 1990 in northern Maine continues to be particularly severe along the Aroostook River. It also seems to be present to some extent in brown ash stands wherever they occur in Aroostook County. In 1991, we noticed a similar problem on brown ash in the Kennebec County town of Mount Vernon.

Affected trees exhibit severe crown dieback. Typically the top half of the crown is nearly or completely dead while the lower half consists of weak branches with poor growth. Epicormic branches are frequent along the bole.

Both paper company land managers and basket makers from local Indian tribes have expressed concern for the future of this resource. Ash dieback causes the wood of affected trees to become brittle and therefore unsuitable for basketmaking.

The cause of this problem continues to elude us. Apparently, though, this is not a new disease. We find record of it in the Forest Commissioner's Reports for the years 1954-1956 where a brown ash dieback with similar symptoms was described but no cause could be identified. After 1956 there was no further mention of this disease.

Ash Leaf and Twig Rust (caused by Puccinia sparganioides) - No specimens of this disease were received in 1991 and infection levels appeared to remain low.

Ash Yellows (MLO) - This disease has not yet been found in Maine so far as we know.

Beech Bark Disease [caused by Beech scale (Cryptococcus fagisuga) and Nectria coccinea var. faginata] - Cankered trees are common throughout the state and extensive mortality of the beech resource continues to occur. However in many stands a few trees remain with smooth, uncankered bark and it seems likely that these individuals are resistant. If so there may be an opportunity to manage stands to generate a higher percentage of healthy stems. It has been suggested that as infested trees are cut the stumps be poisoned (using, for example, Garlon 3A or Tordon RTU) to prevent root sprouting. Stumps which have supported healthy stems should be left untreated to encourage sprouting. As yet this is a theoretical approach and is only now being tested experimentally. But aggressive land managers may want to try it now, under their own conditions, rather than wait for complete research results.

Chestnut Blight [caused by Cryphonectria (Endothia) parasitica] - Many of the chestnut trees the MFS has distributed to foresters and interested hobbyists over the years continue to thrive, thus far having escaped lethal infection. But they seem to possess no special resistance to

chestnut blight and this year we had reports that one had succumbed in Brunswick and another, at a different Brunswick location, was on its "last legs."

We continue to be optimistic that hypovirulent strains of the causal organism will eventually make possible the restoration of American chestnut to eastern forests. [Hypovirulent strains are sublethal, and have the potential to convert the lethal (virulent) strains found in nature to sublethal status]. Thus far hypovirulent strains, when introduced into stands of chestnut in eastern North America, have apparently not spread sufficiently to reduce the infectivity of the virulent population. But there is evidence that this has indeed happened in parts of Michigan, outside the native range of American chestnut. There are at least 30 American chestnut stands in Michigan that are now surviving infection and, in fact, in several of these stands almost all signs of C. parasitica have disappeared.* Hopefully as we increase our understanding of the mechanisms of hypovirulence, a way will be found to facilitate the spread of hypovirulent strains in eastern forests.

Dutch Elm Disease [caused by Ophiostoma (Ceratocystis) ulmi] - See Section D.

Hardwood Anthracnoses (caused by various fungi) - While we received a few calls this season relative to hardwood anthracnoses, their incidence seemed to be generally down. Dry weather when leaves were most susceptible to infection (during growth flush) apparently failed to provide for adequate infection periods.

Oak Wilt (caused by Ceratocystis fagacearum) - To date there is no evidence that this disease occurs in Maine.

Spring Frost Damage (see also Sections C and D) - Frost injury to **hardwoods** was conspicuous across much of the southern half of the state, especially on oak and beech, following a cold snap early on May 19. Perhaps the most severe damage occurred to red oak in the Blue Hill area, in Liberty, Palermo, and Cherryfield and in the Penobscot River Valley north of Old Town. Damage to beech was more common across central and eastern Maine. The stage of plant development on May 19 had a great influence on the severity of damage. Other tree species displaying symptoms of frost injury were locust in Blue Hill and ash at several locations.

Recovery of trees has been somewhat variable. Oaks in most cases have done very well and many previously devastated stands in eastern Maine appeared fairly lush and green by late July. Beech in northern and central Maine, however, remained thin and off color for the balance of the season. Beech foliage in these areas was small and/or deformed, and twig and branch mortality was common. Some whole tree mortality was observed. Most of the affected beech stands are suffering from a complex of problems ranging from drought to oystershell scale, beech scale/nectria and previous season feeding by a variety of defoliators.

*McDonald, W.L., and D.W. Fulbright, 1991. Biological control of chestnut blight: use and limitations of transmissable hypovirulence. Plant Disease 75(7): 656-661.

Many of the more seriously impacted trees may not survive. Next season will likely reveal just how serious the impact of the cold snap this past spring actually was.

Wind Damage (see also Sections C and D) - While Maine experienced several episodes of strong winds during the growing season of 1991, hurricane Bob on August 19 and 20 was by far the most damaging. Especially hard hit were native stands of poplar, although many native oak and a high number of black locust were uprooted as well. Other species seemed to fare a bit better although extremely wet soils (rainfall was commonly 5-8" from this storm and soils were wet before the storm) apparently contributed to the uprooting problems. Where trees were still windfirm, stems commonly snapped in the high winds. Damage appeared to be most severe west of the Kennebec River.

(C) Plantation, Regeneration, Nursery and Christmas Tree Pests Conifers Only - (See also Section A)

Insects

Aphids (*Cinara* spp. and other related species) - Populations of these dark, bead-like aphids were again common on the boles and branches of many conifers. They were most noticeable on spruce and fir in plantations or on ornamental trees. The main concern involves the production of sticky honeydew which attracts yellowjackets and ants and supports an unsightly buildup of sooty mold fungus.

Balsam Gall Midge (*Paradiplosis tumifex*) - Populations of this pest have been at damaging levels around the State since 1986. This past season (1991) midge populations seemed to decline slightly, but over 200 acres of balsam fir Christmas tree plantations are known to have received insecticide applications. Applications of diazinon or chlorpyrifos to control this midge proved very effective. While populations appeared to begin a general decline in 1991, plantations should still be carefully monitored in May to determine whether or not population levels justify control efforts.

Balsam Shootboring Sawfly (*Pleroneura brunneicornis*) - Several Christmas tree growers have expressed concern over the levels of damage their trees have received as a result of larval feeding by this insect. Effective control techniques have not been developed for this pest. The habit of boring down the axis of the newly expanding shoot make this insect difficult to reach with anything but systemic insecticides.

Balsam Twig Aphid (*Mindarus abietinus*) - Twig aphid populations continue to vary greatly from plantation to plantation with at least very light levels in most balsam fir plantations. Control programs were initiated in many plantations in 1991 with generally poor results. The early onset of warm weather seemed to accelerate the fir host development while the aphids lingered on and eggs hatched over an extended period of time. Insecticide applications timed to bud greening and first nymphal instars are usually extremely effective, but this season proved to be too early. While damage in these situations was reduced, the level of control was not as high as hoped.

Fir Coneworm (Dioryctria abietivorella) - Tip mining activity by this species was not generally noticeable in 1991 and few reports of damage were received. One black spruce plantation in Lynchtown exhibited light damage from this species in conjunction with moderate to heavy white pine weevil feeding.

Grasshoppers (species not determined) - Although grasshoppers were still common in many Christmas tree plantations in 1991, damage appeared to be light. Balsam fir plantations in converted fields appeared to be most often bothered by grasshopper feeding.

Gypsy Moth (Lymantria dispar) - Surprisingly little damage to softwood in plantations was reported in 1991. See Special Reports Section.

Hemlock Looper (Lambdina fiscellaria) - High larval populations of the hemlock looper in woodlands in eastern Maine this past season apparently caused some defoliation of softwood in adjacent plantations. Some Christmas tree growers felt that damage, especially to balsam fir, was sufficient to warrant control. "Tippers" who tried to gather wreath brush in some eastern Maine areas had to relocate due to noticeable feeding damage on fir. See Special Reports Section.

Jack Pine Problems - See Section A.

Larch Problems (See also Section A) - The list of pests affecting larch over the past few years has been fairly lengthy. The more serious: European larch canker, armillaria root rot, and eastern larch bark beetle seem to be primarily associated with older established stands. Problems such as larch casebearer, larch sawfly, Leucostoma canker, Sirococcus shoot blight and porcupine damage, however, appear to be more of a threat to younger plantations. There are also many other presently minor and/or local problems affecting larch.

Mites (various species) - Mite populations were heavy again in 1991 in some conifer plantations. This tends to be a perennial problem in some plantations requiring periodic control measures. (See Spruce Spider Mites in this section).

Pales Weevil (Hylobius pales) - Adult pales weevils damaged a white pine planting in central Maine in 1991. A shelterwood cut had been completed at this site in 1990 and weevils emerging from the stumps caused light to moderate seedling mortality. Damage from the drought conditions of June and July exacerbated losses in this particular plantation.

Pine Fascicle Mite - See Section A.

Pine Leaf Adelgid - See Section A.

Pine Spittlebug (Aphrophora parallela) - Spittle masses containing the nymphs of this species were again very visible on a variety of conifers in 1991. Although populations were fairly high, damage was not noticeable and control was not necessary.

Saratoga Spittlebug (Aphrophora saratogensis) - This insect continues to be a chronic problem on some sites but especially in frost pockets, and varies in intensity from year to year. Populations in 1991 seemed to be at roughly the same levels as they have been since 1988. Most infested areas are still in eastern Maine where pockets of mortality have been observed. Planting has been curtailed in the barrens of eastern Maine because of this pest. This problem continues to be site and ground cover related.

Seedling Debarking Weevil (Hylobius congener) - No reports of damage by this weevil, often referred to as the **regeneration weevil**, were received in 1991.

Spruce Budmoth (Zeiraphera canadensis) - Plantation surveys for this pest were not conducted in 1991. Although heavily infested white spruce plantations were still in evidence, the problem seems to have stabilized. Many landowners made a management decision to stay away from planting white spruce a number of years ago, thereby reducing the number of susceptible plantations. Those white spruce plantations which still exist will continue to be seriously affected by the **spruce budmoth, spruce gall midge** (Mayetiola piceae), **gall aphids** (Adelges spp. and Pineus spp.) and **spruce bud scale** (Physokermes piceae).

Spruce Budworm - See Section A.

Spruce Spider Mites (Oligonychus ununguis) - Spruce spider mites have become a more significant problem to Christmas tree growers as the market diminishes for low quality trees. Competition for limited markets has lowered the amount of damage buyers will tolerate requiring growers to take control measures more frequently than in the past. Individual plantations must be examined in June and July to assess mite populations because there is often a great variation in population levels even in adjacent fields.

The choice of miticides available to Christmas tree growers has been restricted in recent years due to registration problems with Kelthane, but in 1991 Rohm-Haas Co. applied for and received a 24(c) registration allowing the use of Kelthane 35. Kelthane may be used for control of two-spotted and spruce spider mites on Christmas trees grown in Maine. Growers in states other than Maine should consult with local registrations prior to buying or using this product.

Strawberry Root Weevil (Otiorhynchus ovatus) - For the first time in several years, no reports of destructive larval populations or damage to conifer roots was received.

White Pine Weevil (Pissodes strobi) - The white pine weevil is quite likely the most damaging economic insect pest of eastern white pine in Maine. Larval feeding on the cambial tissue of the terminal shoot usually causes the death of the terminal and first whorl of shoots below it. While most trees survive, the result of the lost terminal is a multiple stem. While corrective pruning to a single healthy shoot is beneficial, the first log

from infested trees will likely have a slight crook or grain distortion. Successive attacks often destroy any potential to obtain quality logs from the tree in the future and limit tree use to either pulpwood or chips.

Although white pine weevil is primarily a pest of white pine, both Norway and Colorado blue spruce experience heavy damage. Other pines and spruces may also become infested but usually to lesser degrees. Often the leaders of red or black spruce will be attacked, but the broods don't survive well. Damage to red or black spruce is often exhibited by distorted leaders with heavy amounts of dried pitch on their surface. This was the case in a black spruce plantation in the Parmachenee area in 1991. Many trees in this plantation were weakened so that they broke over easily especially when infested by the fir coneworm as well.

Yellow-headed Spruce Sawfly (Pikonema alaskensis) - Defoliation of ornamental spruce, especially Colorado blue and plantation white spruce, by the gregarious yellowish-red headed larvae of this sawfly was fairly common but local again in 1991. No woodland infestations were reported.

(C) Plantation, Regeneration, Nursery and Christmas Tree Pests (Conifers Only)

Diseases and Miscellaneous Problems

Annosus Root Rot (caused by Heterobasidion annosum) (syn. Fomes annosus) - This disease was confirmed from two previously uninfested red (Norway) pine plantations in 1991. While white pine and Norway spruce are occasionally infected, this disease is primarily a concern on red pine in plantation situations in southern and western Maine.

The significance of this disease in Maine plantations is difficult to assess. In the southern states, where intensive plantation forestry has been practiced for years, this disease has been quite destructive, but only on certain sites. Whether Maine has sites likely to be conducive to very destructive losses from this disease has yet to be determined. Since the potential is there, we recommend stump treatment with borax at the time of all thinnings. However, we are anything but certain that this practice is cost effective on all sites.

Balsam Fir Needle Rusts (caused by various fungi) - The incidence of needle rusts (fir-fern and fir-fireweed rusts) was generally low in 1991 on foliage of plantation Christmas trees in southern and central Maine. However we received several reports from Aroostook County of heavy needle rust infection on foliage of woodland balsam fir which was sufficiently damaging as to render the brush useless for wreath manufacture.

Bud Abortion - Bud abortion of balsam fir, caused by low ambient air temperatures occurring just prior to bud break, was not severe in most Christmas tree plantations around the state in 1991. This can be one of the most serious and least controllable problems affecting Christmas tree

growers. This was the third straight year where most vegetative buds flushed normally, and this allowed remaining unsold trees to substantially recover from the severe outbreaks of bud abortion we experienced in 1987 and 1988.

Deer Browse Injury - Deer continue to be a serious problem in many balsam and fraser fir Christmas tree plantations, especially in southern and central Maine. Typically deer browse first year outplants the hardest, often nipping all foliage and vegetative buds from those seedlings.

One grower in North Yarmouth has quantified the extent of his damage. By January 1991, 99% of last year's outplants had been browsed. Forty-three percent were lost (few or no viable buds remaining). Coincidentally, that same percentage of loss occurred to the previous year's planting during the previous winter (1989-90). Assuming a value of $1.50 per transplant (cost of purchase, planting, herbicide and mowing the first year), this grower's economic loss for his 1990 planting was $4200.

Deer browse damage was also severe to yews (Taxus ?cuspidata) at a seasonal residence in Auburn during the winter of 1990-1991. Not content to confine their damage to outlying plantings, deer had jumped a low chain link fence to browse patio shrubs around a family swimming pool adjacent to the house.

Pine Needle Rust (caused by Coleosporium asterum syn. Coleosporium solidaginis) - In early June we received several red pine specimens which were heavily infected by Coleosporium needle rust. The disease was spectacular in certain young plantations in Mayfield, Moscow, Brighton and Dixfield.

Like many (not all) rust fungi, Coleosporium asterum has an alternate host. In Maine the alternate host is frequently goldenrod, which is commonly abundant in old fields planted to red pine. Once plantation pine has developed sufficiently to close a canopy, the goldenrod becomes shaded out and the problem all but disappears.

As spectacular as the expression of this disease may be, it is generally of minor importance. In the most seriously affected plantations, growth of young pine may be temporarily retarded, but tree mortality is rare.

Porcupine Damage - Porcupine injury to plantation trees appears to have become more common in recent years. One Christmas tree grower, frustrated with attempts to "gas" the creatures in their dens with woodchuck "bombs" and finding the application of repellents to be expensive and time consuming, found the old fashioned shotgun to be much more effective. Porcupines may be shot whenever encountered. But perhaps the most productive time to eliminate these pests is on warm, early spring days before leaf emergence when porcupines sun themselves in the crowns of trees around the perimeters of plantations.

Scleroderris Canker (caused by Ascocalyx abietina) - No new infestations of this disease were reported during 1991.

Sphaeropsis Blight (caused by Sphaeropsis sapinea syn. Diplodia pinea) (See also Section D) - This disease, primarily of two-and three-needle pines, seems to be increasing in severity in recent years, especially on red pine in mid-coastal areas. Plantation pines seem especially hard hit with symptoms ranging from tip blight to death of entire trees.

In ornamental situations Scotch, Austrian, pitch, and mugo pines are often infected but control is possible through timely application of benomyl or copper fungicides. This approach is impractical in forest plantations, however. Since the disease seems to persist indefinitely once it is established, moving the harvest date ahead may be the most practical remedy for severely infected plantations.

Spring Frost Damage (see also Sections B and D) - Emerging shoot growth of balsam fir was injured in Christmas tree plantations statewide by frost on the nights of May 19 and 20. Only plantations which were well elevated above the surrounding terrain managed to escape with little injury. Damage was also severe in neighboring states and Canadian provinces.

Observations suggest that white, Scotch, and red pine, and fraser fir, were much less sensitive to frost injury than balsam fir. However, concolor fir appeared to be quite a bit more susceptible.

Wind Damage (see also Sections B and D) - Many 6-12 foot Japanese larch in a plantation near China Lake were left tilted toward the southeast following the passage of Hurricane Bob in August. While some trees will straighten by themselves, the root systems of others have broken the surface of the ground on the windward side and consequently will develop a butt log with a substantial and permanent sweep.

Tender, elongating shoots of several species of conifers were severely damaged by wind during the statewide passage of a cold front in late June. Strong northwest winds blew and twisted or broke succulent shoots resulting in a disrupted water supply and subsequent shoot mortality. Damage was particularly severe to white pine and balsam fir, and worst on the northwest sides of exposed trees. This front was also accompanied by very local severe, twisting, tornado-like winds. One such area involved nearly one hundred acres in South Orrington. Another severe storm in Aroostook County on August 1 was accompanied by large hailstones and strong winds. Damage was especially severe in Blaine and North Bridgewater over several square miles.

Winter Injury (see also Section D) - The severe winter browning which occurred to plantation trees, especially Scotch pine Christmas trees, during the winter of 1989-90 did not recur during the winter of 1990-91.

(D) Shade Tree, Ornamental and Miscellaneous Pests

Insects and Ticks

This section provides a summary of those "other" problems which were encountered by I&DM staff over the past year. Most of the more common new, unusual or serious problems are discussed individually. However, some have

been grouped due to similarities in habit or impact. For instance most of the **sucking insects**, especially those which produce **honeydew**, have been grouped with the **aphids**. Those insects and **ticks** which **bite, sting, irritate** or **parasitize** people have been grouped under **medical entomology**. Our staff also handles a large number of routine requests for information on such things as **carpenter ants, other ants, clusterflies, earwigs, snowfleas, cockroaches, galls** (caused by mites, wasps, flies and aphids), **erineum**, etc. These were serious to those requesting advice and it is not our intent to slight the importance of these problems. More information on any of these items is available upon request.

Alder Flea Beetle (Altica ambiens alni) - It was easy to tell where the alders were this past year, at least in southern Maine. Alder flea beetle larvae "browned up" alder over large areas during July. This species must have had a good winter as populations were up noticeably in many areas from 1990 levels. When larvae of the alder flea beetle run out of food before reaching maturity, they wander, and wander they did! Most reports of wandering by the shiny blackish larvae of this species occurred in mid to late August. Larvae were often observed on and within buildings immediately adjacent to infested alder. Several commercial establishments even conducted control measures to stop migration into buildings when customers began to complain. This was the first time anyone has felt they had to go to this extent for this species.

Although no aggregation of the small, oval and metallic blue-black adult beetles was noted this past fall prior to overwintering, this phenomenon may be more common as the beetles re-emerge with the warmer days of spring in April or May. Overwintering can occur in protected sites in buildings (within the walls, etc.), hollow cavities in rocks and trees and in litter adjacent to defoliated areas. Emerging beetles often cover all objects nearby.

Ant Flights (Lasius spp. and possibly others) - Ant flights were again common over southern, primarily coastal, Maine in late August. One apparently massive flight went down at sea off the southwestern Maine coast at that time. As a result a ridge of dead and dying ants which washed ashore stretched for a mile or more along the beach in Biddeford Pool.

Aphids, Adelgids, Psyllids, Treehoppers and Scales (various species) - Aphid populations were unusually high this past season on a wide variety of hosts and the sticky **honeydew** deposits from **aphids**, as well as **treehoppers** and **scales** on infested trees, often caused concern. Where populations were extreme, some stress related problems may result.

The situation in 1991 again fit this scenario: Early in the season (May to mid-June) numerous reports were received as frail, winged adults of a number of aphid species filled the air in the vicinity of infested birch **(birch aphids)**. Little was then noticed in the aphid world until late in June when some of the various **adelgid galls of spruce** including the **pine leaf adelgid** (see Section A) begin to open and spill their tiny, winged occupants into the wind. From mid July through August sticky honeydew produced by the feeding of **treehoppers** and **scales** on oak and

Cinara aphids on conifers coated many objects beneath infested trees. Aside from making a mess, honeydew drew ants, flies and a variety of wasps and hornets. If not washed off, honeydew coated surfaces soon became darkened as they were overgrown by **sooty mold fungus.** A last gasp of summer occurred in late September and October as numerous, tiny, bluish-green aphids with tufts of white wool attached drifted lazily through the air on calm, sunny days in the vicinity of alders **(woolly alder aphids).** Aphids in one form or another are always there but most of the rest of the time you have to look for them.

Armyworm (Pseudaletia unipuncta) - Although fairly large larval migrations of this species were observed again this season, no reports of activity of concern to tree crops such as Christmas trees were received.

Bark Lice or Psocids - These interesting creatures were common again in southern Maine in 1990. There are several species which occur in substantial numbers in Maine. Our most common species on tree bark appears to be Cerastipsocus venosus. These psocids first appear as patches of tiny tan specks on the bark of various hardwoods and conifers in July. As they mature they turn gray with lighter cross-banding and may reach 3/16" in length at maturity. They remain together as tiny "herds of grayish bugs" through much of July and August. Adults have dark smoky-gray wings with a triangular light spot on each forewing. After they develop wings in August they lay eggs under tiny, white silk mats on tree bark and "disappear." Bark lice feed on lichens and fungi on the tree bark and not on the tree itself so they do no harm.

Boxelder Bug (Leptocoris trivittatus) - Populations of this species in the Sanford area were still in evidence in 1991 but numbers appeared to be down. This is the only area where the boxelder bug occurs commonly in high numbers in Maine so far as we know. It is often confused in Maine with the more common and widespread **smaller milkweed bug** (Lygaeus kalmii).

Browntail Moth (Euproctis chrysorrhoea) - Known populations of this introduced pest continue to be confined to the Casco Bay area. Roughly 50 acres are known to be infested on Long, Vaill, Little Diamond, House and Chebeague Islands plus an additional unknown amount on the mainland and probably other islands in the area as well. Two to three acres of heavy to severe defoliation was reported on Long Island. Vaill, House, Little Diamond and Chebeague are now generally infested. Scattered overwintering webs were reported from seven adjacent mainland towns in 1991. Although defoliation by this species is readily noticeable, it is the often serious skin irritation caused by hairs from the caterpillars which cause the most concern. Many requests on how to deal with this irritation were handled in 1991. See **rash** in Medical Entomology in this section.

Cottony Maple Scale (Pulvinaria innumerabilis) - Populations of this species were very low and barely detectable in 1991.

Eastern Tent Caterpillar (Malacosoma americanum) - Populations of this species were down again in 1991 even from very low 1990 levels.

Euonymus Caterpillar (Yponomeuta sp. prob. cagnagella) - This species was back again this year in most areas infested in 1990. We again received reports from many areas of southern Maine west of the Penobscot River and south of Route 2. One of the more "spectacular" infestations involved a long euonymus hedge adjacent to a local business in Bangor that was completely stripped and "festooned" with webbing. In some areas where populations were extreme in 1990, the owners controlled the populations by chopping down the Euonymus shrubs and burning them. Rather drastic but it worked!

Hunter's Moths (adults of several species of cankerworms) - There are several species of fall flying moths which begin their flight activities just after the hemlock looper moths finish theirs. These male moths (females are wingless) tend to fly from mid October through November and due to the colder temperatures at that time of year do so mainly on sunny days and on warmer nights. Frail, lightly marked, tan moths, with a one-inch wingspan which are often active in numbers in hardwood areas during hunting season (November) are most often adults of either the **fall cankerworm** (Alsophila pometaria) or **Bruce spanworm** (Operophtera bruceata). Heavier-bodied, often darker, moths which are less abundant but which also fly on warm nights in the fall are more likely adults of one of the cutworm species (Noctuidae).

Japanese Beetle (Popillia japonica) - Japanese beetle populations have continued to spread and now occur, at least locally, throughout much of southwestern Maine. Heaviest populations occur in Androscoggin, Cumberland, Kennebec and York Counties. Populations have begun to appear in other areas as well at least as far north as the Bangor area. Although Japanese beetles feed on a number of trees, especially birch, maple and oak, there is no doubt now that little-leaf linden (Tilia cordata) is one of their favorites. The tops of small trees less than thirty feet in height appear to be preferred and it is easy to spot linden at a distance in infested areas by the tan, off-colored, skeletonized foliage.

Lacebugs (Corythuca spp.) - Butternut and birch continued to have higher than usual numbers of lacebugs in 1991 especially in ornamental or shade tree settings. Infested leaves showed characteristic yellow mottling, especially along the veins. The flat, lacy looking adults and nymphs were visible on the underside of the leaves along with brown flecking from feeding, cast skins and waste material.

Locust Leafminer (primarily ? Parectopa robiniella) - Black locust throughout much of southern Maine exhibited moderate to severe browning this past season from feeding by one or more species of leafminers. Populations of the **locust leafminer** (Odontota dorsalis) were down noticeably in Lewiston and so far have not been found elsewhere. The **digitate mines** commonly attributed to Parectopa robiniella appeared to be the most common. In a few cases characteristic **blotch mines** caused by another unidentified species were predominant. Heaviest leafminer populations were observed in the Lewiston, Blue Hill and Deer Isle areas and along Interstate 95 from Augusta to Bangor.

Lyme Disease in Maine - The current status of Lyme disease in Maine is still difficult to determine, due in part to the mobile and frequently changing human population and the nature of Communicable Disease Center diagnostic criteria for inclusion in this status. There is now a total of 26 Maine acquired cases of Lyme disease recognized by the Maine Dept. of Human Services, Bureau of Health (Disease Control). The following is a list of the counties of exposure and number of cases in each: Cumberland (7), Hancock (3), Lincoln (3), York (11) and undetermined (2). There are still many other persons who claim to have become infected. Some of these may have acquired the disease out of state while others may have begun treatment for suspected infections thereby eliminating the value of confirmation tests. Still others who were bitten by ticks began prophylactic treatment and assumed that a tick bite meant that they had acquired the disease, which is not necessarily true. Maine still has relatively low and spotty vector tick (Ixodes dammini) populations and these are still primarily in the coastal areas of the State (see Ticks which follows).

Maple Petiole Borer (Caulocampus acericaulis) - Owners of sugar maple shade trees often become startled early in June when they find a bed of newly fallen leaves beneath their healthy trees. The leaves, which are usually green and fresh, have been chewed off by the tiny larvae of this insect. Although this effect is striking, the species seldom causes a serious problem. Often an infestation may be restricted to one tree and only in one year. Each larva feeds only in one leaf petiole. About 5-7 days after the leaves drop, the hollowed remainder of the petiole containing the larva falls to the ground. The larva then enters the soil where it will remain until next season. The infested petioles can be collected and destroyed if one wishes to reduce the infestation potential although this is usually not necessary. We received reports of activity of this species in 1991 especially from Kennebec County. There were also reports of leaf drop due to other causes.

Medical Entomology - Maine does not have a designated medical entomologist position and as a result many of the requests for assistance in this area of expertise fall upon I&DM staff. This involves a wide variety of problems from **ticks, mosquitoes, blackflies** and **wasps** to **spiders** and insect related **allergies and reactions.** Inquiries involving disease transmission, however, are referred to others.

Biting fly populations in 1991 ran the usual range of mild to terrible but overall were not unusually severe. The activity period for **mosquitoes, blackflies, deerflies** and **"no see-ums"** occurred roughly on schedule and, although it provided periods of great discomfort in some localities, these did not last excessively long in general. The hot spots in 1991 involved a late season flush of **salt marsh mosquitoes** along the immediate coast from Penobscot Bay southwest to the New Hampshire border. These mosquitoes of open lands seldom move into wooded areas or very far from the shore. Populations of salt marsh mosquitoes appeared to be higher in 1991 than they have been in many years. **Blackflies** in the Penobscot River valley north to Medway were also very "pestiferous" this season. Populations of this river breeding complex of species build

as the season progresses and "cookouts" were all but impossible even in early September in some areas. **"No see-um"** and **deerfly** populations appeared to be stable or down generally in 1991.

Yellowjacket colonies were very large and populous and the inhabitants extremely aggressive this season, especially after the colonies reached maximum size in August. Although there are an estimated 14 species of yellowjackets in Maine, most of the problems with people and stings seemed to involve the more aggressive **eastern yellowjacket** (Vespula maculifrons), **German yellowjacket** (Vespula germanica) and the **common yellowjacket** (Vespula vulgaris). These species were often seen chasing people around and stinging many. There were stories of yellowjackets entering cars at traffic lights and stop signs, travelling up ladies skirts and men's pants, "heckling" customers at roadside fruit and vegetable stands, driving picnickers inside, entering soda cans and moving into grocery stores, barber shops and beauty parlors. Yellowjackets are definitely attracted to some fragrances especially those of some fruit and cosmetics. Males of the eastern yellowjacket chewed into homes "en masse" on several separate occasions looking for mates or a way out of colonies which were established with the walls. Fortunately males do not sting; workers and queens do. When held in perspective, this unusually heavy year for stinging insects has produced some interesting and often humorous tales.

There are 11 species of **hard ticks** (Ixodidae) which have been reported from Maine over the past several years as a result of Lyme disease-tick surveillance efforts. Of these eleven, only three; Dermacentor variabilis, Ixodes cookei, and Ixodes dammini, have been commonly involved with humans. Of these three only I. dammini is a confirmed vector of the Lyme disease bacteria. In 1989, I. dammini was thought to be restricted to a band along the coast east to Columbia Falls and rarely more than 20 miles inland. Records acquired in 1990 showed scattered distribution much further inland than previously thought. Ixodes dammini was found in 1990 as far north as Bethel, Madison, New Sharon, Patten and Burlington. In 1991 more, but still scattered, inland records were recorded and I. dammini had been found as far east as Calais. Research on ticks, their biology, host associations and relationship to the Lyme disease bacteria in Maine is being conducted by the staff of the Research Department of the Maine Medical Center in Portland. A paper on tick species found in Maine and the distribution of the more common species mentioned here is now available (Amer. J. Publ. Health 1992; 82:66-69).

Another tick, the **moose** or **winter tick** (Dermacentor albipictus) was unusually abundant this past year. Normally this one-host tick stays on moose throughout its life cycle in Maine but in the fall of 1991 larval populations were so extremely high in lowland moose habitats of central and southern Maine that the ticks became a hunter problem. Tiny questing larvae attached themselves to anyone or any creature that passed within leg reach of "their" bush. Hunters often reported hundreds on their clothing when they returned home at the end of the day. In a number of cases individuals found themselves covered with a rash of tiny bites and many a laundry basket or closet was covered with wandering larvae.

Larvae and adults were also much more common this season on horses (feeding adults) and dogs (transporting primarily). This seemed to be a very unusual season for this species. We sure pity the moose in infested areas.

Rashes associated with the hairs of caterpillars such as the **browntail** and **gypsy** moths seemed to be more of a problem in 1991 than for a number of years and many requests for advice in dealing with these problems were received. Although the mode of action of the hairs is somewhat different, chemical in the case of browntail and mechanical in the case of gypsy moth, the treatment recommended is the same. People who react very easily to irritants such as these were encouraged to stay away from heavily infested areas and caterpillars as much as possible. Those who had to venture forth could find some relief through proper use of over-the-counter formulations of antihistamine (such as Benadryl) and hydrocortisone creams. Persons with severe reactions or who had mucous membranes or eyes affected were referred to their physicians. Fortunately rashes acquired from caterpillars generally do not last as long or spread as readily as rashes resulting from poison ivy.

Bot fly (Cuterebra sp.) larvae were removed from the chin of a baby girl and lower side of an older man in Kennebec County in 1991. Although reports such as this come to our attention periodically, it was unusual to have two in one year. These flies most commonly parasitize small rodents.

Black Widow Spiders (Latrodectus hesperus) - A "rash" of reports of black widow spiders in western grapes prompted a lot of concern in June and July of 1991 throughout much of the northeast. Reductions in spray applications in California apparently allowed black widows to stay alive and hidden in grapes and packing crates on their journey eastward. Fortunately no bites were reported even though 15-20 spiders were collected from grapes in Maine. One Maine distributor had taken the precaution to obtain a species identification and to import a stock of anti-venom.

One of the large (1" long body) **fishing spiders**, Dolomedes tenebrosus, was extremely common in and around buildings in forested areas of central Maine from late May through July of 1991. As many as 6 females were found in one home in Readfield over a two week period by startled occupants. This species is not poisonous.

Mountain Ash Sawfly (Pristiphora geniculata) - This species appears to be on our list of perennial problems affecting ornamental mountain ash. The 1991 season was no exception with the usual complaints in spite of the fact that control of the problem is fairly easy to achieve.

Rose Chafer (Macrodactylus subspinosus) - This species was very common again this season in southern Maine causing locally noticeable defoliation of a wide variety of trees and shrubs. Although rose chafers occurred throughout the area, locally high populations stripped greenery from everything from ferns to trees. These tawny, spidery looking native beetles occur earlier (June) than Japanese beetles although their damage in some cases is every bit as severe.

Wild Riceworm (Apamea apamiformis) - Wild rice seed heads were again devastated in Kennebec, Lincoln and Sagadahoc Counties in August and September of 1991 by larvae of this species. Records have shown periodic outbreaks of this species in these areas for many years. This is at least the second consecutive year in this outbreak and some rice stands are beginning to look thin.

Willow Insects - Defoliation of willow by a variety of insects was reported again this season. The **imported willow leaf beetle** (Plagiodera versicolor) and the **willow flea weevil** (Rhynchaenus rufipes) were the most common and populations seemed to remain at roughly 1987 levels for the fifth season. This is a perennial problem in many areas and fairly easy to control.

(D) Shade Tree, Ornamental and Miscellaneous Pests

Diseases and Miscellaneous Problems

Armillaria Root Rot (caused by Armillaria spp. - See also Section A) - We received calls for assistance with this problem on ornamental plants from Augusta and Lewiston in 1991. In Lewiston portions of an arborvitae hedge were affected; in Augusta a maple was dying. The causal fungus is ubiquitous, however, and is capable of infecting hundreds of different plant species. For years armillaria (shoestring) root rot was considered to have been caused by a single species (A. mellea) but more recent study indicates a group of closely related Armillaria species all are capable of causing shoestring root rot, although they vary in their host preferences and pathogenicity.

Boxelder Canker (caused by ? Fusarium lateritium) - Death of scattered branches in the crowns of boxelder was common and very conspicuous throughout southern and central Maine during the summer of 1991. Cankers were found to be widespread in affected trees on both present year shoots and older stem tissues.

We have been able to isolate and repeatedly associate two different types of fungi with cankers. One is a species of Fusarium (possibly F. lateritium or F. roseum) and the other a species of Coryneum (possibly C. negundis). It seems likely that the hard spring frost Maine experienced on May 19 predisposed boxelder to infection. Probably the causal fungi present the potential for infection every year, but it takes a stress "trigger" such as frost injury to initiate a substantial disease outbreak.

Hurricane Bob stripped many of the dry, brown leaves from affected branches in August and this resulted in a generally improved overall tree appearance. However cankered branches are still present and the potential for a recurrence of this disease next season remains, especially if the trees are stressed again by frost or some other similar factor.

Cristulariella Leaf Spot (caused by Cristulariella spp.) - This disease, which caused extensive leaf spotting and defoliation especially of boxelder in south central Maine in 1990, all but disappeared in 1991. Apparently the weather conditions which favor this disease, consecutive days and nights with high dew points, did not recur last summer.

Deer Browse Injury - See Section C.

Dutch Elm Disease (caused by Ophiostoma ulmi syn. Ceratocystis ulmi) - Dutch elm disease continues to take a steady toll of Maine's few older remaining large elms. These trees seemed to escape or resist the initial wave of infection which spread through the state several decades ago, but a new wave of an aggressive subgroup of the causal organism is proving too much for many of these older survivors. Even intensive efforts in certain southern Maine communities to save remaining large elms by targeting them for special protection are no longer very successful.

An article by Dr. David Houston in the July issue of Plant Disease* documents the spread of this aggressive subgroup in New England. The replacement of the original strain by the aggressive subgroup is now nearly complete in Vermont, and even in Millinocket, Maine nearly 90% of cultures taken from infected elms now yield the aggressive strain. Dr. Houston notes the population of elms in New England has predominantly shifted from large to smaller trees, and that the rate of infection of even these smaller trees is now progressing at an accelerated rate.

Eastern Dwarf Mistletoe - See Section A.

Hardwood Anthracnoses - See Section B.

Mechanical Damage - Misuse of string trimmers accounts for an increasing percentage of the tree problems we observe in residential, park, and industrial settings as well as in cemeteries and on golf courses. Often the damage to tree stems is relatively inconspicuous even when tree crowns have progressed well into advanced stages of decline.

Sirococcus Shoot Blight (caused by Sirococcus conigenus - See also Section A) This disease remained at normal levels on ornamental species in 1991. In 1989 disease incidence had been high, infecting especially Colorado blue spruce in landscape situations. But in 1990 such infections seemed to return to normal levels, and remained so during this past season.

Sphaeropsis Blight [caused by Sphaeropsis sapinea (syn. Diplodia pinea) - See also Section C] - Sphaeropsis blight, also known as Diplodia tip blight, was confirmed from pitch pine in Windham and mugo pine in Auburn during April. This disease is rarely serious on native conifers growing in natural situations, but ornamentals of cone bearing age and plantations

*Houston, D.R. 1991. Changes in Nonaggressive and aggressive subgroups of Ophiostoma ulmi within two populations of American elm in New England. Plant Disease 75(7):720-722.

can become seriously affected, with new infections occurring each year. Considerable branch mortality often results and while pruning of infected branches may improve tree appearance, this practice is not usually sufficient to prevent new infections.

Spring Frost Damage (see also Sections B and C) - Frost injury to gardens, ornamentals, blueberries, and forest and Christmas trees was widespread but spotty throughout Maine following freezing temperatures in the early morning hours of May 19 and 20. Especially hard hit were ornamental bamboo [Japanese knotweed (Polygonum cuspidatum)] and the native sensitive fern (Onoclea sensibilis). While few tears were shed over injury to these two species, damage to the Christmas tree and blueberry industries was quite serious.

Winter Injury (see also Section C) - Winter injury to evergreen foliage, so pronounced on landscape shrubs during the winter of 1989-1990, was much less severe this past season. Even the more tender landscape cultivars seemed to come through the mild winter relatively unscathed.

Wind Damage (see also Sections B and C) - Street and shade trees were extensively damaged by high winds as hurricane Bob passed through Maine on August 19 and 20. Power lines were down seemingly everywhere as a result, and many areas were without electric power for as long as a week.

Compiled and Edited by Richard G. Dearborn and Clark A. Granger

91-7 Insect & Disease Management Division Augusta, Maine

Forestry Related Quarantines in Maine

There are four forestry related quarantines which are in effect in Maine. They are: White Pine Blister Rust, Gypsy Moth, European Larch Canker, and Hemlock Woolly Adelgid.

I. The White Pine Blister Rust Regulations and Quarantine are listed under Title 12 MRSA 1988, Subchapter III, Section 803:8305 Shipment Prohibited.

The director may prohibit, prevent or regulate the entry into or movement within the State, from any part thereof to any other part, of any plants of the genus Ribes or other nursery or wildling plants, stock or parts of plants which may cause the introduction or spread of a dangerous forest insect or disease. The director may issue the necessary orders, permits and notices necessary to carry out this section which shall not be considered to require or constitute an adjudicatory proceeding under the Maine Administrative Procedure Act, Title 5, Chapter 375.

Regulation: White Pine Blister Rust, Quarantine on Currants and Gooseberry Bushes.

A. The sale, transportation, further planting or possession of plants of the genus Ribes (commonly known as currant and gooseberry plants, including cultivated wild, or ornamental sorts) is prohibited in the following Counties in the State of Maine, to wit: York, Cumberland, Androscoggin, Kennebec, Sagadahoc, Lincoln, Knox, Waldo, Hancock, and parts of Oxford, Franklin, Somerset, Piscataquis, Penobscot, Aroostook, and Washington.

B. The planting or possession of European Black Currant, Ribes nigrum or its varieties or hybrids anywhere within the boundaries of the State of Maine is prohibited. This quarantine is administered by the Insect & Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

II. The Gypsy Moth Quarantine is listed under 7 CFR Part 301, United States Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection and Quarantine as printed in the Federal Register.

A. This quarantine designates the infested area in Maine as quarantined for the movement of regulated articles, which includes wood such as logs, pulpwood, chips, etc., and requires the inspection and certification of such material if movement is to non-infested states and foreign countries. This is administered by the USDA-APHIS, PPQ in Bangor, Maine, phone 945-0479.

B. Inasmuch as Maine is not completely infested and quarantined, wood or regulated articles moving from the infested area of the state to the non-infested area must be accompanied by a certificate or go to a mill under state compliance agreement which allows the reception of such articles. Regulated articles moving from the non-infested area of the state to other non-infested states or countries must be accompanied by a state permit stating that the regulated article originated outside of the infested area of the state. This is managed by the Insect & Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

III. The European Larch Canker Quarantine is listed under 7 CFR Part 301 of the United States Department of Agriculture, Animal & Plant Health Inspection Service, as published in the Federal Register, and also under Title 12 MRSA, Section 8305 of the Laws of the State of Maine.

A. This quarantines all parts of larch (Larix spp.) including logs, pulpwood, branches, twigs, etc, as regulated articles.

B. Also any other product, article, or means of conveyance whatsoever, when it has been determined by an inspector that it presents a risk of spread of the disease.

C. Designates parts of Hancock, Knox, Lincoln, Waldo, and Washington counties as the quarantined area from which movement is restricted.

This is managed by the USDA-APHIS, PPQ in Bangor, Maine, phone 945-0479, and the Insect and Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

IV. The Hemlock Woolly Adelgid Quarantine is listed under 7 MRSA, Chapter 409, Section 2301-2303 of the Laws of the State of Maine.

This quarantine was adopted to attempt to prevent the introduction of the Hemlock Woolly Adelgid (Adelges tsugae Annand) into Maine. This pest has been found to cause mortality of Eastern Hemlock (Tsuga canadensis) in infested states. Since hemlock is a major component of Maine's forest on over one million acres, protection of this valuable resource from damage by the Hemlock Woolly Adelgid is essential.

A quarantine is established against the following pest and possible carriers.

A. Pest:. Hemlock Woolly Adelgid (Adelges tsugae Annand).

B. Area Under Quarantine: The States of Connecticut, Delaware, Maryland Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, Alaska, California, Oregon, Washington, and the District of Columbia.

C. Articles and Commodities Covered: Hemlock seedlings and nursery stock, logs, lumber with bark, and chips..

D. Restrictions: All articles and commodities covered are prohibited entry into the state from the area under quarantine unless specified conditions (listed below) are met.

1. Hemlock seedlings and nursery stock are: admissible into Maine provided each lot is accompanied by a certificate issued by the Department of Agriculture or Conservation of the State of the origin with an additional declaration that said material is free from Hemlock Woolly Adelgid.

2. Hemlock logs, lumber with bark, and chips are: admissible provided that said material is only shipped to preapproved sites within Maine. Such shipments must be made under a compliance agreement between the shipper and the Maine Forest Service, Department of Conservation. If said material is shipped to other sites, it must be accompanied by a certificate issued by the Department of Agriculture or Conservation of the state of origin affirming (a) the material was grown in the state of origin, and that either (b) the material is free from Hemlock Woolly Adelgid, or that (c) the material originated from an uninfested area in the state of origin.

This quarantine is administered by the Maine Department of Agriculture, phone 289-3891 and the Insect and Disease Management Division of the Maine Forest Service, phone 289-2431 or 289-2791.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 6 - Feb. 1992

Gypsy Moth in Maine - 1991
Prepared by Richard Bradbury

Gypsy moth populations remained epidemic in 1991. Aerial surveys delineated 620,933 acres which received some degree of defoliation this year, primarily in southwestern Maine. If the population were to follow the trend of the 1979-82 outbreak, 1991 would correspond to the peak year of 1981 and the size of the infested area would diminish in 1992.

Overwintering mortality due to cold winter temperatures usually depresses gypsy moth populations in Maine, but this mortality factor had little impact in the winter of 1990-91. Egg masses collected in March and April of 1991 exhibited 90-100% hatch at most locations in the southwest with a high index of hatching success per egg mass. Egg parasitism by Anastatus disparis and Oencyrtus kuvanae was common at most collection sites, but not at levels sufficent to limit defoliation.

First hatch was reported April 29th at Waterboro and Hiram. The development collections of May 6th had up to 28% of the egg masses showing some larvae resting on the masses and some hatch at all locations. The peak of the 1st instar was around May 13. The most desirable target for Bacillus thuringiensis application is the peak of the 2nd instar which occurred around May 25. Development sampling was done biweekly until June 24th when nearly all larvae were mature and pupation had begun in Waterboro.

While the viral "wilt" disease was reported from a range of sites throughout the infested area this season, egg masses appeared to be generally healthy. Parasitism by Oencyrtus kuvanae was very heavy in the Windham-Standish area when checked in August. No surveys were conducted this season for the larval fungus disease caused by Entomophaga maimaiga although casual observations would indicate that the impact was lower in 1991 than in 1990.

The Maine Forest Service participated in the USDA-FS 1991 Cooperative Gypsy Moth Suppression Program (CGMSP). This program reimbursed participating agencies up to 50% of the actual application costs. This program was offered only to town governments and not to individual associations. Initial letters informing town managers of the program were sent to all towns (98) which sustained defoliation in 1990. Managers were asked to respond if they wished to have their town considered for inclusion in the program. At that time thirteen towns expressed some level of interest in participating in the program. Eight of the towns dropped the program by March either because of lack of funds or very limited sprayable acreage. Ultimately only the town of Livermore remained in the project with 140 acres meeting project criteria.

The spray blocks in Livermore were treated on June 6 using 40 BIU of Dipel 8 AF. The high dosage was required because the larvae were nearing the peak of the 4th instar. Public notification requirements had not been met in time and the spraying had to be delayed for ten days. June 6th was overcast and cool with a light breeze from the west. The spray deposit was good and this was confirmed with spray cards.

The level of control achieved was disappointing but not unexpected given the delay in application. Larval mortality was moderate, but was very slow to occur because of the large size of the larvae. Homeowners had mixed opinions of the program, but the majority felt that the defoliation and nuisance level would have been much higher without the treatment.

Several privately funded control programs were conducted in 1991. Most of these involved small stands and the results were also mixed. In many cases control was good to excellent but because of high larval populations in adjacent areas, in-migrations negated the aspect of foliage protection.

The 1991 aerial gypsy moth defoliation survey was delayed due to State budgetary constraints making it necessary to map refoliation in many areas. The accuracy of location of the defoliation seemed to be high, but the intensity values placed on the defoliation was often times an educated guess. The defoliation acreage equalled 620,933 acres which can be broken into three levels of intensity: 280,569 acres >60% defoliated, 213,556 acres 30-60% defoliated and 126,808 acres <30% defoliated (see Figure 1 and Table 1).

In October 1991, towns were contacted to inform them of the intensity and location of defoliation in their towns and were told the MFS would not participate in the 1992 CGMSP. The principal reason for not operating a cooperative project was the poor participation in the 1991 project. The cost to the MFS to perform the increased intensive surveys necessary to properly plan small scale control projects is quite high and cannot be justified if most towns do not actually undertake suppression efforts.

Table 1.
Acres* of Woodlands Defoliated by Gypsy Moth in Maine in 1991 by County

County	Low	Medium	High	Total
Androscoggin	11209	15004	25141	51354
Cumberland	24243	74237	82842	181322
Franklin	141	972	3699	4812
Hancock	0	2181	0	2181
Kennebec	2395	1851	4300	8546
Knox	30	0	0	30
Lincoln	0	877	267	1144
Oxford	32990	57205	90329	180524
Sagadahoc	462	644	1826	2932
Somerset	348	0	0	348
York	54990	60585	72165	187740
Totals	126808	213556	280569	620933

* These figures differ somewhat from our October 1 Conditions Report due to further refinement.

Egg mass population levels were sampled at 78 sites in October of 1991 using fixed (one/two hundredth acre) and variable (10 BAF prism) plots at each site. In southwestern Maine, 33 of 51 plots had greater than 250 egg masses per acre. The remaining sites were located in eastern Maine and all contained less than 100 egg masses per acre. Egg mass size was highly variable this season ranging from predominantly "dime" size to the more typical two inch long mass. The phenomenon is a reflection of the variability of the health of gypsy moth populations throughout the infested area. Site specific surveys of egg numbers revealed a variety of scenarios. A number of sites which received heavy defoliation in 1991 had very few or very small egg masses which is to be expected. Unfortunately some sites at which the populations dropped out in 1991, based on defoliation, had high numbers of healthy egg masses. This information would suggest a more gradual decline in the gypsy moth infestation than in 1982 with shifting areas from year to year of heavy defoliation within southwestern Maine.

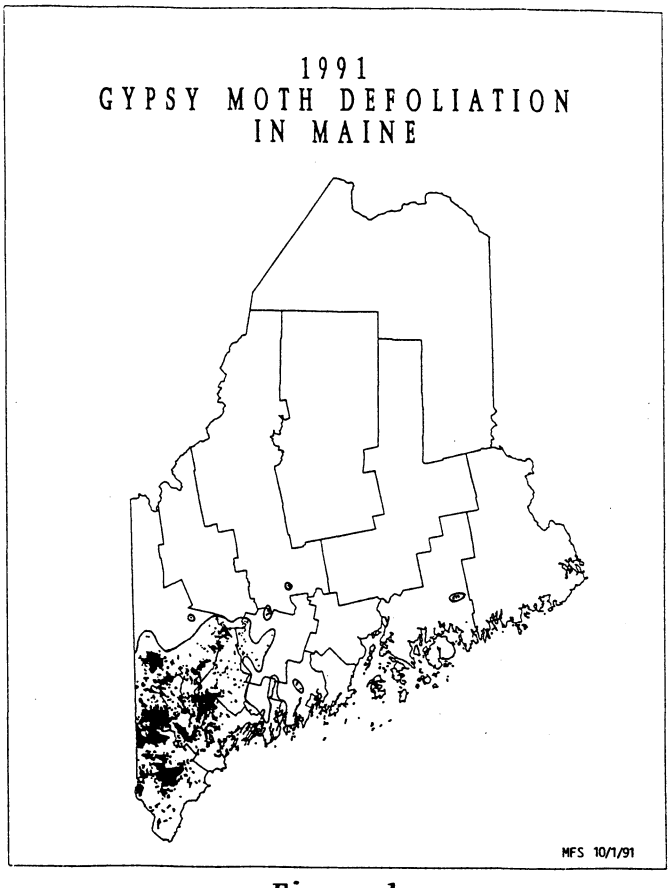


Figure 1

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 6 - Feb. 1992

White Pine Blister Rust Control Program - 1991
Clark Granger

The Maine Forest Service has annually conducted a white pine blister rust control program since 1917, the year after this disease was first detected in Maine. While there have been many program refinements, the basic approach has remained the same. That has been to eliminate (eradicate) the alternate host plants of this disease (currants and gooseberries) wherever they occur within infective range of commercial quality white pine trees, and to maintain a quarantine against the importation and cultivation of susceptible alternate host plants. (See Forestry Related Quarantines in Maine p.).

For reasons of economy and efficiency, the MFS does not attempt to directly protect white pine in all sections of the state and instead concentrates its limited funds in areas where most commercial white pine occurs (generally the southern half of the state). Within this area certain sections are targeted for control efforts each year based upon the quality of pine to be protected, proximity of the pine areas to blister rust scouts hired for that season, and availability of recent aerial black and white and infrared photo coverage. During 1991 currants and gooseberries (ribes) were scouted and eradicated in the following municipalities:

Augusta	Minot
Bowdoin	New Gloucester
Bowdoinham	Pownal
Chesterville	Vassalboro
Farmington	Wilton
Gray	Windham

Eradication (destruction) of ribes plants was accomplished through application of Tordon RTU, a herbicide applied at the rate of 8 oz. per gallon of water using non-powered spray equipment. The total amount of undiluted Tordon used in 1991 was 296 oz. (18.5 pounds). This was adequate to eradicate 20,518 individual ribes plants on 16,792 acres. Actual pine acres protected totalled 7,720, an effort which required 1,702 person hours of labor.

This control program is expected to continue in 1992, and areas to be scouted have already been delineated on aerial photographs for use by the scouts.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 6 - Feb. 1992

THE HEMLOCK LOOPER IN MAINE - 1991
and
A FORECAST FOR 1992

Prepared by
Henry Trial Jr.

Introduction

The infestation of hemlock looper [Lambdina fiscellaria (Gn.)], which first appeared in Maine in 1988 as abnormally heavy moth activity, has increased rapidly in size and intensity. The acreage showing heavy to severe defoliation increased from 450 acres in 1989, to 20,000 acres in 1990, and to 225,000 acres in 1991. Defoliation in 1991 was extremely intense in many portions of the outbreak area due to a combination of high larval density, excellent larval survival, and very dry conditions during larval feeding. While some infested areas experienced significant declines in population density and defoliation in 1991, other areas maintained high populations and received very heavy damage. Also, many areas of heavy damage were detected in previously uninfested regions. Most of the heavy to severe 1991 defoliation occurred in east-central Maine in Penobscot, Hancock, Washington, and Aroostook counties but, significant areas of intense feeding were mapped in a band along the coast from Kittery to Calais. Heavy defoliation occurred on hemlock, balsam fir, and white spruce.

In response to the greatly increased demand for technical information and assistance on the hemlock looper problem from individual landowners and forest based industries as well as its own mandate for resource protection, the Maine Forest Service (MFS), Insect and Disease Management Division (I&DM) increased detection and evaluation surveys of the looper infestation. Larval, damage, and predictive egg surveys will be described in this report. Data concerning the current hemlock looper infestation have been made available to town officials, forest industry representatives, and concerned individuals to assist in their management of this damaging pest.

Larval Development

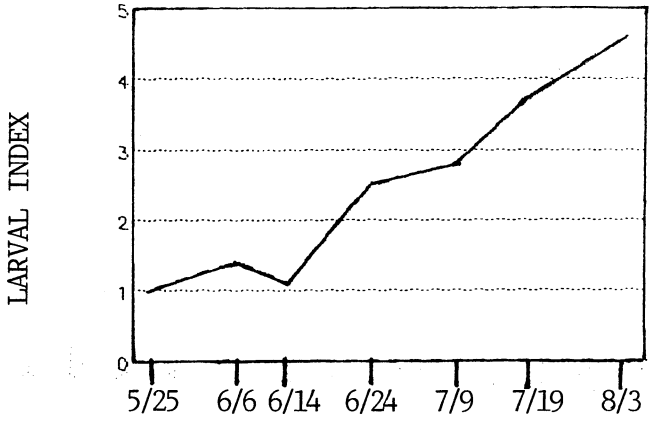
Seasonal development of hemlock looper larvae was tracked throughout the summer of 1991 in order to provide information to those interested in surveying or controlling looper populations. This data will also add to the historical record of this outbreak.

Development samples were collected periodically from two locations. One location in Jefferson was used to time a spray project undertaken by several area residents. Collections at this site were discontinued once spraying was completed. The other site in Lincoln was followed through most of the larval cycle. Larvae for each development sample were collected from branches of 3 to 5 overstory and 3 to 5 regeneration hemlock trees. At the Lincoln site populations were high and only a small portion of each branch was needed to obtain 50 to 100 larvae. Larvae were placed in a vial of alcohol and taken to Old Town for instar determination. Seven samples were taken at the Lincoln site during 1991.

A larval index was calculated by multiplying the number of larvae per instar by the number of the instar and then dividing by the total number of larvae. For example, 25 1st instar plus 25 2nd instar larvae would give an index of 1.5 (25x1 +25x2 = 75 /50 = 1.5). The seven development samples collected from Lincoln in 1991 were graphed to show the progression of development (Figure 1).

In Lincoln and in other areas there was an early emergence from the eggs and a relatively steady progression through the instars. Larval emergence in 1989 and 1990 had not occurred until the first week in June. In 1991 larvae were active in several areas by the 25th of May and this seven to ten day advance over 1989 and 1990 continued through the entire cycle. The first pupae and moths were also a week or more early compared to 1990. The stable warm and dry weather kept larvae developing at a steady rate. One unusual feature of 1991 development was an extremely long period of egg hatch that apparently had two distinct hatching peaks. The dip in the development curve on June 14 was not due to a sampling variation but rather to a delayed hatch of many eggs. The collection contained many tiny larvae which had just hatched and were smaller than 1st instar larvae collected on June 6. This second hatch was also noted in the Jefferson development samples. The reason for this occurrence is not known, but it does not seem to be related to a delay in hatching caused by weather.

Figure 1; Hemlock Looper Larval Development, Lincoln, Maine - 1991



Larval Observations

Population levels predicted from 1990 egg density were checked in the spring of 1991 using a larval "beating" survey. Resources were not available to check all areas covered by the general egg survey but many areas where landowners had expressed an interest in the looper infestation were checked. The method for this survey was similar to procedures used in Newfoundland. A meter square beating frame (a wood frame with white cloth stretched over the frame) was held under a single meter long branch on the sample tree. The branch was then beaten with a stick to dislodge larvae, which would fall to the cloth. The larvae were then counted to assess population. This was done on three trees in each area sampled. While this method has limited accuracy, results did seem to reflect egg counts. Samples taken in areas where egg counts predicted low defoliation rarely produced larval counts exceeding 10 larvae per branch, whereas counts in high egg density areas usually exceeded 50 larvae per branch. Several areas with egg counts in the severe category had larval counts greater than 100 and some counts exceeded 250 larvae.

Moderate egg densities produced the most variable larval counts. In these areas larval count ranging from three to 172 larvae per branch.

Larval survival is difficult to assess for hemlock looper because larvae are very mobile and are easily dislodged from branches by wind and rain or during the sampling process. Larval counts from tree mid crowns will be much lower immediately after a heavy rain than they would be after a day without wind or rain. When large numbers of larvae are dislodged from the tree, the time necessary to climb back up the tree is highly variable. Also, many larvae are lost during this type of event. These sampling problems lead us to base our evaluation of survival on the results of periodic samples, tempered by subjective observations.

Larval survival was quite low in 1989 and 1990, ranging between 5 and 18%. The range of survival from first to fifth instar in 1991 was estimated at 14 to 23%. The 1991 survival was probably significantly better than survival in 1989 and 1990. The primary reason for this increased survival was probably the warm dry weather in 1991 and the lack of wind or heavy rain that would have knocked larvae to the ground. Several wind and rain events occurred in 1990.

Another factor known to significantly affect looper survival is disease. Larvae were not cultured for disease organisms in 1991, but populations were checked for obviously sick larvae and very few were observed except in the Lakeville area. Lakeville has one of the oldest and most persistent infestations observed during this outbreak. Preliminary egg sampling in this area shows that egg density for 1992 is far below the 1991 level. Populations in this area seem to be collapsing. Populations in other parts of the infested area have also collapsed where sick larvae were not seen.

Defoliation

An aerial survey of 1991 hemlock looper defoliation was completed in late September and a generalized map of the area showing moderate to severe damage was prepared (Figure 2). The 225,000 acres shaded black on this map received heavy to severe defoliation (greater than 45% total tree defoliation of hemlock or balsam fir) in 1991. Lightly shaded areas on the map, representing more than 100,000 acres, contain stands that were moderately defoliated by looper. Because moderate defoliation by looper, especially on fir, can not be readily mapped from the air, some of the areas of moderate damage shown on the map represent the results of ground detection. Most of the moderate defoliation recorded occurred on fir. Figure 2 is only intended to show the general location of 1991 looper damage. The MFS also prepared more detailed computerized maps that were sent to town offices in the affected areas.

The 1991 aerial survey for looper damage began in August and continued through late September. The appearance of defoliated stands changed considerably through this period. Early in the survey, defoliated stands of both hemlock and fir were a very noticeable reddish-brown color. This color was caused by numerous partially eaten dead needles which persisted on the trees in looper silk. The summer of 1991 was relatively dry and there were few wind or rain storms to dislodge this accumulated dead foliage. This kind

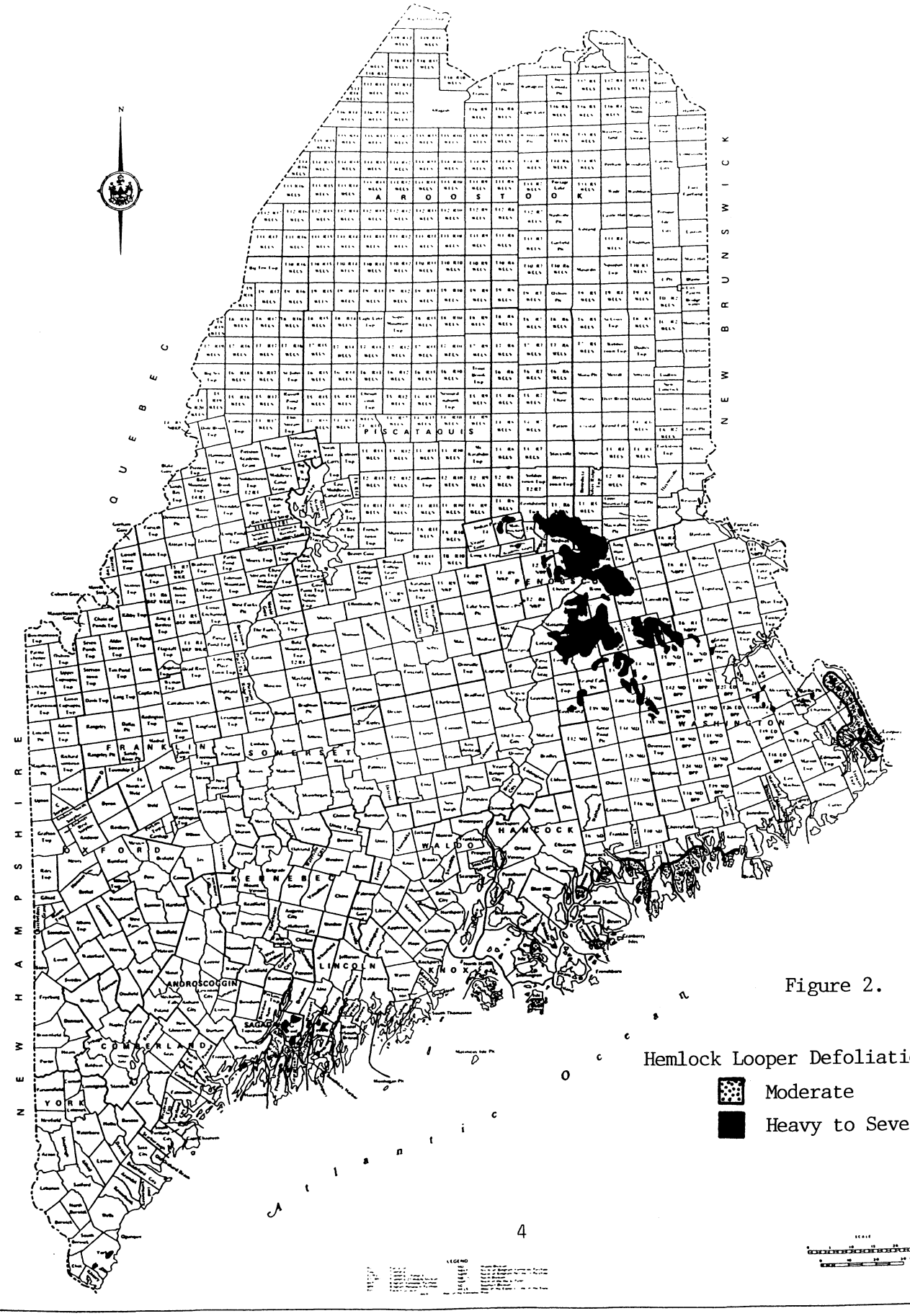


Figure 2.

Hemlock Looper Defoliation-1991

Moderate

Heavy to Severe

of prominent browning had not been seen during the 1990 survey. Later in the survey period several wind and rain storms, including hurricane Bob (August 19 and 20), removed the dead needles. Thereafter, hemlock stands appeared a bronze color in the severely defoliated areas and a silver green in moderate areas. Another striking feature noted late in the survey was 5 to 10 feet of bare top on trees in the more heavily defoliated areas.

The most intense and largest area of looper defoliation in 1991 occurred in central Penobscot county. The heaviest defoliation in this area occurred on the hemlock component of commercial stands owned by several of the state's larger landowners. Many hemlock stands in this area experienced defoliation exceeding 75% of the total foliage complement. Total defoliation in some stands exceeded 90% and the survival of a significant portion of the affected hemlocks in these stands is doubtful. Mature fir in these areas generally received light to moderate damage while fir regeneration was heavily defoliated.

Numerous small areas of defoliation were mapped on the islands and mainland along the coast from Kittery to Calais. Even though these areas are small and patchy, most have extremely intense damage, occurring on high value residential or recreational properties, and are of considerable concern to the owners. West of the Penobscot River, damage occurs predominantly on hemlock. In contrast, east of the Penobscot River damage occurs on fir and white spruce.

Larval populations in coastal areas east of the Penobscot River were high enough to cause visible damage (browning of newly expanding shoots) on balsam fir and occasionally white spruce by mid June. As these larvae developed, they removed nearly all of the four or five years of old needles usually carried by fir and spruce. In the heaviest areas, larvae ate all or most of the 1991 needle compliment after finishing the old needles. Several coastal islands had areas where looper totally defoliated understory fir and occasionally white spruce regeneration. Total defoliation of mature fir and white spruce was rare, but was seen in a few small areas.

Owners of residential and recreational properties in the central Penobscot county area were also significantly affected by looper damage. Lake shore properties were generally the most heavily damaged and some property owners may lose the hemlock component from their stands.

Light Trap Survey

Several of the light traps in the Maine Forest Service, Insect and Disease Management Division network were operated during September to evaluate hemlock looper moth activity. The light trap network in Maine consists of 23, mostly (Rothamsted) incandescent, light traps spread throughout the state. Normally traps are operated from mid June through the end of July. Beginning in 1990, the MFS extended the operating season for seven of the traps to include September, which covers most of the looper flight season. In 1991, nine traps were operated during September for looper moth evaluation over a somewhat larger area (Figure 3).

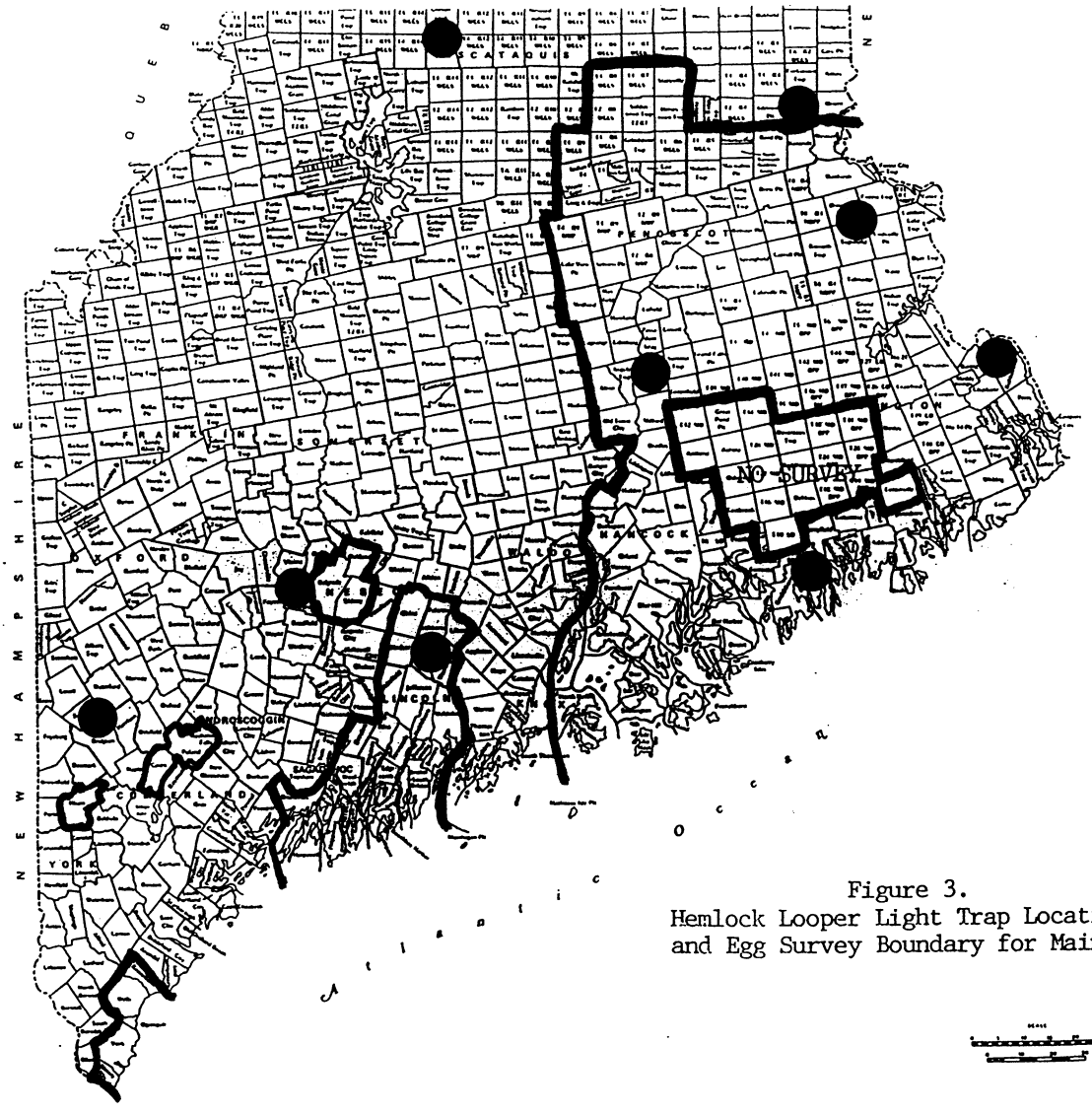


Figure 3.
Hemlock Looper Light Trap Locations
and Egg Survey Boundary for Maine - 1991

Four of the traps operated in 1991 had been operated in the same location in 1990 and one other trap was operated in a different location within the same town. Two of the 1990 locations were dropped in 1991 and four new locations were added to the survey in 1991.

Hemlock looper moths were caught in all nine traps in 1991 (Table 1). The highest number of moths (5402 for the season) was caught in the Calais trap; a new location in 1991. The second highest catch also occurred in eastern Maine at the Steuben trap. This trap was in a different location than the Steuben trap where over 3800 moths were trapped in 1990. The operator of the 1990 Steuben trap operated a personal trap in 1991. He reported similar or even higher than the 1990 moth catches at his trap in 1991. The extreme catches that occurred in southeast coastal Maine (Steuben) in 1990 and 1991 were in an area where the primary looper hosts were balsam fir and white spruce. Extremely heavy moth activity at the Calais trap in 1991 was probably

originated from local spruce-fir type and relatively large areas of hemlock type upwind of the trap. Unfortunately, the MFS does not have any light traps located near the largest area of heavy looper activity on hemlock in central Penobscot county.

The only other trap with a high 1991 catch was in Topsfield (142), and this catch was less than half that collected in 1990 (411). The remaining six traps had low looper catches in 1991. Of the three other traps operated in the same locations in 1990 and 1991, North Bridgton had a slightly higher catch in 1991, whereas, the 1991 catch was down at the Chesuncook and Haynesville traps.

The 1991 moth emergence began in late August in some areas. This was earlier than the beginning of the emergence period in 1990. The earliest emergence noted in 1991 was August 18 in the Woodville area in central Penobscot county. This area did not have a nearby light trap that was operated in September. The Calais and Steuben traps caught moths on September 1, the first day of the operating period. In 1992 the MFS plans to start looper trap operation in mid August to determine if there is significant moth activity prior to September.

Most moth activity occurred between the 1st and the 20th of September (Table 1) and the heaviest activity was early in the month (4th-6th). In 1990, two activity peaks were recorded rather than a single period as seen in 1991. As in 1990, cold overnight temperatures greatly reduced moth activity. Temperatures below freezing can readily reduce an expected catch of several hundred per evening to less than 15. This was the case at the Calais location on the 11th and 12th.

The sex of looper moths caught during the 1991 light trap survey was determined (Table 1) and, as in 1990, the majority of traps caught mostly female moths. Calais, Steuben, Topsfield, and Greenbush traps caught several times more females than males. Traps at Mt. Vernon and Haynesville caught about twice as many females as males but both traps had low total catches. The North Bridgton, Washington, and Chesuncook traps caught more males than females. The Chesuncook trap had produced more females than males in 1990 and the North Bridgton trap caught more males in both years. The reasons for the differences in the percentage of females caught are not known. The traps producing mostly females in 1991 were all in eastern Maine and downwind of high looper populations as well as being within very high local populations. Traps that caught more males were in areas of relatively low or declining looper populations. Males are thought to emerge from the pupal stage before females.

The MFS received reports of looper moth activity from sources other than our light traps. Many residents of coastal Hancock and Washington counties reported "swarms" of hemlock looper moths in their woods and near lights at night. One homeowner from Cranberry Isles reported that moths "covered trees and buildings" and that "you couldn't take a deep breath for the moths". Industry foresters from the central Maine area reported heavy moth activity in area hemlock stands. The largest number of moths witnessed by MFS staff occurred in fir areas from Calais to Perry. In addition to moths seen in

Table 1

1991 Hemlock Looper Light Trap Survey

Lambdina fiscellaria

Station	Sex	September 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Totals
Calais	M	14	7	18	66	36	26	29	24	20	12	3	10	17	11	6	4	7	3	2	2	0	0	0	0	0	0	1	0	0	0	318
	F	3	38	148	727	494	1033	390	191	129	319	8	3	403	319	110	367	197	150	19	21	2	0	0	7	2	4	0	0	0	0	5084
Chesuncook	M	0	7	3	3	0	2	1	0	4	3	0	0	3	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	30
	F	0	0	4	0	0	0	0	0	0	3	0	0	0	0	1	1	4	2	0	0	0	1	0	0	0	0	0	0	0	0	16
Greenbush	M	0	0	0	1	1	0	0	0	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
	F	0	0	0	3	0	1	1	2	1	24	0	0	0	0	1	8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	42
Haynesville	M	0	0	2	2	0	0	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
	F	0	0	1	1	0	0	0	0	0	11	0	1	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
Mt. Vernon	M	0	0	0	1	0	3	0	1	1	1	0	0	0	2	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	13
	F	0	1	0	0	0	1	0	0	1	1	0	0	1	6	1	2	3	1	0	0	0	0	0	0	0	0	0	0	1	0	19
No. Bridgton	M	0	0	5	9	2	6	1	4	4	11	0	0	5	1	3	12	1	7	0	0	0	0	1	0	3	0	1	0	0	0	76
	F	0	0	2	1	0	1	0	1	1	5	0	0	0	0	2	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	17
Steuben	M	0	0	1	1	2	2	0	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	12
	F	1	0	6	15	18	153	29	21	24	22	16	3	4	5	17	11	8	3	1	0	0	0	0	3	2	2	4	2	0	5	375
Topsfield	M	0	0	5	4	2	3	0	0	0	4	0	0	0	0	1	7	1	2	1	0	0	0	1	0	0	0	0	0	0	0	31
	F	0	0	5	23	2	6	0	0	0	24	1	0	0	0	3	24	2	12	0	0	0	1	5	2	0	0	1	0	0	0	111
Washington	M	2	1	4	2	4	2	2	5	0	1	1	3	1	2	1	0	2	3	5	3	1	2	1	0	1	2	1	1	2	4	59
	F	0	2	0	0	4	1	1	1	4	0	0	0	1	0	0	1	0	1	0	1	1	5	2	0	0	1	2	2	0	2	32

eastern Maine woodlands, a MFS Entomologist observed high numbers of moths floating on the ocean northeast of Lubec.

1991 Predictive Egg Survey

The MFS conducted a survey of hemlock looper egg density in 1991 in and near areas of defoliation. This survey was intended to provide a generalized defoliation prediction for the infested area and to determine population trends throughout the state. To accomplish these goals, two sample points per infested town was considered adequate.

The egg sampling method was the same as that used in 1990. Branches from both overstory trees (three) and regeneration (three) were collected at each sample site from either hemlock, balsam fir, or in a few locations white spruce. Branches were taken to the MFS laboratory facility at Old Town and eggs were extracted and counted using an egg washing method developed in Newfoundland and modified for use in Maine. The average number of eggs per branch from the six branches was used to predict 1992 defoliation. The egg to defoliation relationship developed by the MFS in 1990 (Figure 4) was used for the predictions in this report.

Boundaries of the 1991 egg survey are shown in Figure 3. A total of 411 samples were collected and processed, making the 1991 survey approximately 32 percent larger than the 1990 survey. The increase in the size of the general survey was due to the substantial increase in the size of the infested area in

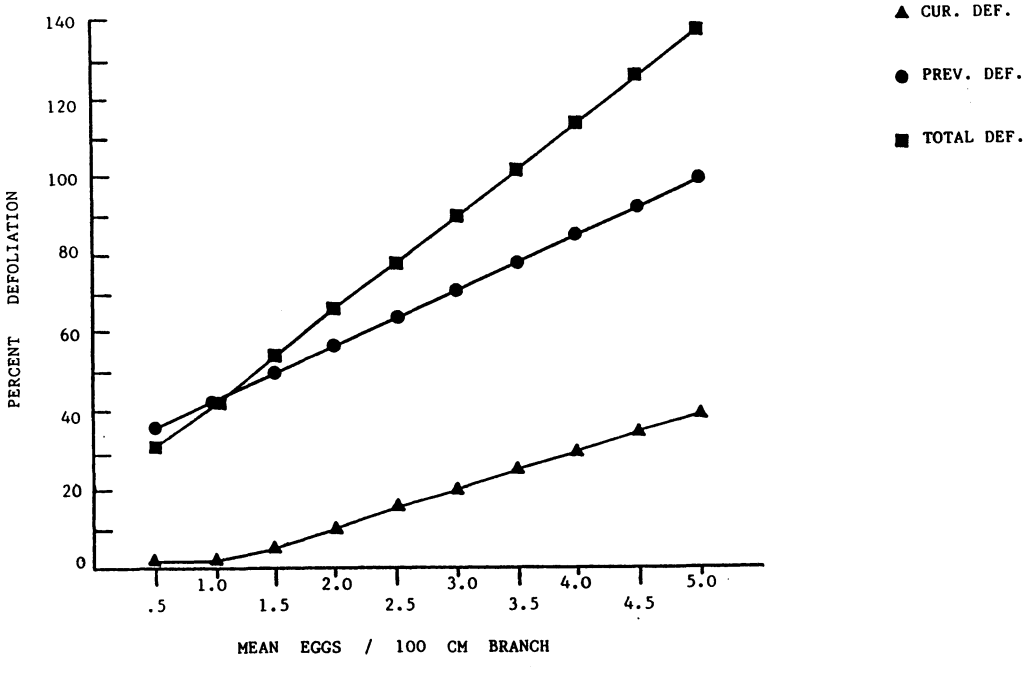


Figure 4. Predicted Defoliations on Hemlock based on the Average of Mid Crown and Regeneration Egg Density per 100 CM Branch-Maine-1991

1991. The 1991 survey began in early November and was not completed until January 30, 1992. The extended duration of the survey was due to the increased area and insufficient Division resources to survey the expanded area in the same time frame as in 1990. Data from the survey were made available to interested parties for inclusion in their management decisions.

A new set of paired egg density and defoliation data was collected during 1991 as part of the method development study begun in 1990. The egg to defoliation predictive relationship used in 1990 and in this report was developed from a single season's data and required confirmation with additional data. The new set of egg and defoliation data will be analyzed prior to the 1992 larval season and a report discussing these variables will be issued. A preliminary review of the 1991 data shows that the relationship developed in 1990 is basically correct. However, egg density alone may not be adequate to predict defoliation in all cases. The defoliation level produced by a particular egg density is apparently greatly affected by factors like the amount of foliage available, the number of years looper has been in an area, weather conditions the next season, and whether the population in an area is healthy.

We have attempted to allow for these variables in our prediction of 1992 damage. The unpredictable factors that will affect the 1992 defoliation level include 1992 larval survival, weather conditions in 1992, and natural population collapses due to disease. Obviously, good weather for larvae and high survival will increase defoliation as will drought conditions, which hurt host trees. A rapid buildup of disease organisms that control looper population can cause rapid population collapse and low defoliation even in areas of high egg density. These variables remain unknown. Past defoliation levels are known, and were considered. Experience with the present hemlock looper infestation has shown that the ultimate level of 1992 defoliation will depend significantly on level of 1991 defoliation. If 1991 defoliation was heavy in an area, fewer "old" needles will be available to 1992 larvae and more 1992 needles will be eaten. Thus, the level of total defoliation may be severe even though egg density is only moderate. Severe egg densities are likely to cause severe defoliation even in the absence of past damage. Experience has also shown that severe or heavy defoliation and a low egg density is usually characteristic of a population decline in the area.

There are several areas of severe egg density (Figure 5), most of which are surrounded by areas of heavy and moderate density. The largest severe area stretches from Calais to Lubec and west to Cooper and Edmunds. Balsam fir is the predominant affected host in this area, but some hemlock occurs in the western part of the area. This area has many patches of severe 1991 fir defoliation, mostly on the eastern border of Washington County. The area of severe egg density is surrounded by smaller zones of heavy and moderate egg density to the north and west. Damage in eastern Washington County is expected to remain severe on patches damaged in 1991 and significant mortality may occur. Also, severe damage is expected to spread to many other areas in 1992. Some survey locations in the eastern portion of this area had the highest egg densities (greater than 30 eggs per branch) recorded in the looper outbreak.

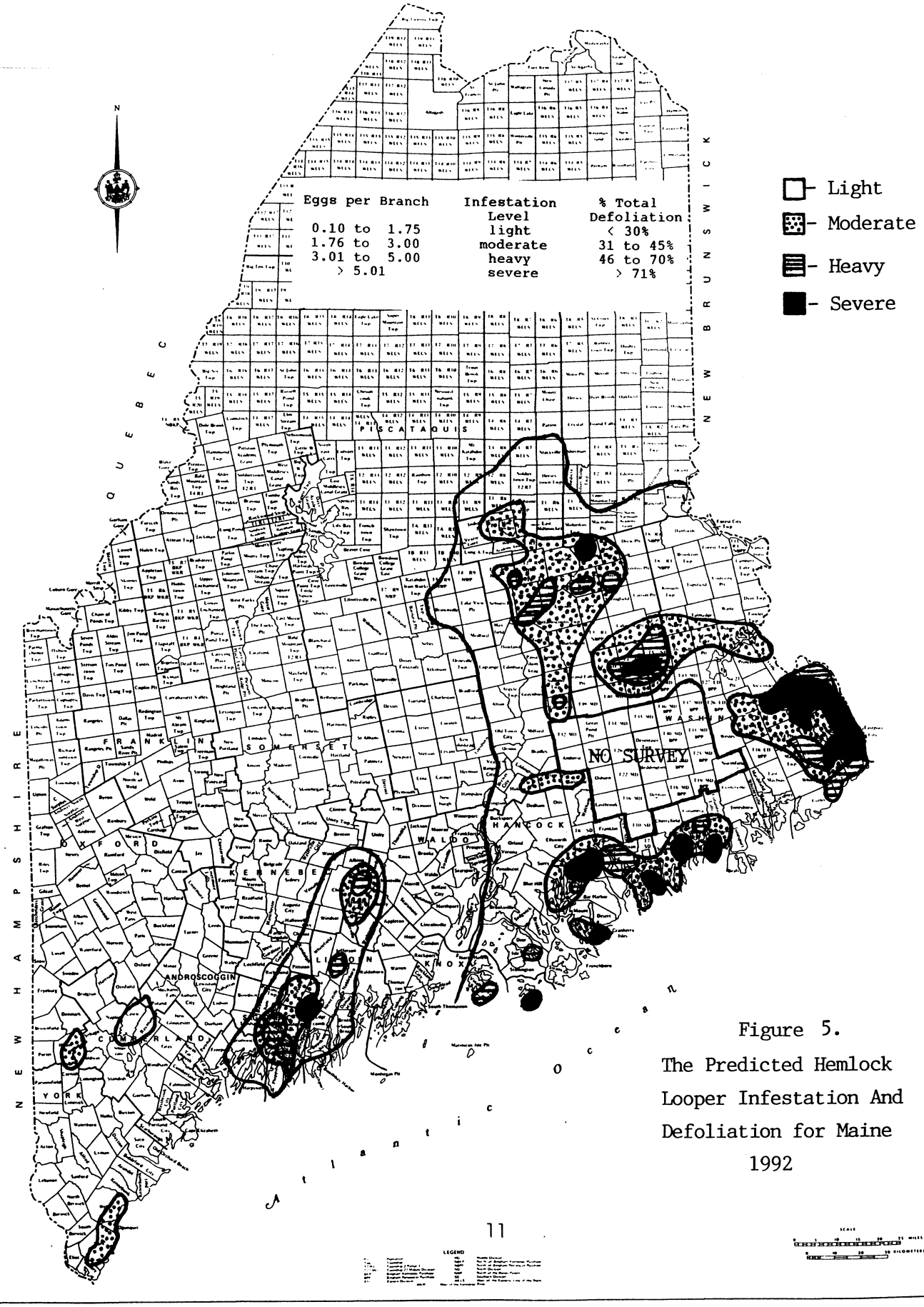


Figure 5.
The Predicted Hemlock Looper Infestation And Defoliation for Maine 1992

More areas of severe egg density were found on fir and white spruce in coastal areas of eastern Hancock and western Washington counties. These severe areas consist mainly of islands and points of land on the ocean. Damage on these areas close to the water was severe in 1991 on both fir and white spruce. Egg density on many survey sites exceeded 25 eggs per branch and some tree mortality is likely in 1992. A band of high egg density was found inland from the coast of Hancock and western Washington counties. Still further inland, population were moderate. Egg density in central coastal Washington county near Machias was very low. An area in coastal Sagadahoc county was found to have high egg densities on hemlock. This area had heavy defoliation in 1991 and favorable larval conditions in 1992 could result in mortality of some hemlock.

The very large area of hemlock forest land in central Penobscot county has shown some decline in egg density compared to 1991 levels. Several towns west of Lincoln continue to have high egg density, but most of the area had moderate egg density predicted in 1992. This is a very large area, and with the heavy to severe damage experienced in 1991, moderate population may be sufficient to cause mortality in 1992. An area of high egg density in northern Hancock county abuts the large moderate area in central Penobscot. Some sample locations in this area had severe counts.

New areas of moderate egg density were found in southern York county and western Waldo county. These areas may grow and intensify in 1992. The remainder of the survey area had low egg density.

Current and Expected Impacts

The MFS established 23 study plots in 1991 to assess the impact of hemlock looper at several damage levels and infestation scenarios. These plots were remeasured in late 1991 but data analysis is not yet complete. In addition to the permanent plots, several severely damaged stands have been studied throughout the infestation to provide a preliminary view of the ultimate impact of looper damage.

Hemlock. Based on a preliminary review of the impact plot data and the overview provided by assessing other selected damaged areas, the MFS now has a more complete understanding of looper impacts. Early in the outbreak many observers thought that due to the extremely heavy damage caused in a single season and the perceived fragility of hemlock, that mortality would be very widespread. However, it is now clear that, while many relatively small hemlock stand have suffered high levels of mortality, many other stands incurring severe damage now seem to be recovering without significant losses. In addition to these extremes, many stands have spotty mortality and many other trees that may or may not survive depending on future stress. At this time, it seems probable that the looper caused mortality on hemlock will not be as widespread as once thought but is still likely to be very significant to some landowners.

Some factors affecting the ultimate impact of looper are better understood now than they were at the beginning of the outbreak. To date, hemlock mortality has not been significant unless total defoliation has

exceeded 90%. Several conditions that have resulted in greater than 90% have been observed. Intermediate and suppressed trees in dense stands are often defoliated to this degree if populations are high. This is mainly because they do not have a large foliage compliment initially. Most scattered mortality occurs in this type of tree.

Most areas where a high percentage of the hemlock in a stand is killed are either stressed by other factors or have populations that are extremely high or have persisted over several years. Stress factors noted in high mortality areas include poor sites, drought, and cutting stress. Cutting in an area when the looper is active also tends to concentrate larvae on the remaining stems causing extraordinary feeding pressure. Individual hemlock stems in hardwood stands also seem to concentrate extreme populations causing mortality. Populations extreme enough to cause extensive mortality are also common near bodies of water, such as on island, points, shorelines, and in stream valleys.

The pattern and persistence of the infestation in an area has an extremely important effect on host mortality. Stands that experience a high level of mortality usually have high or severe population levels for at least 2 years. Stands where only scattered mortality occurs often have one year of heavy or severe damage before populations subside and trees begin to recover. Often total defoliation in these stands approaches 90%, but never surpass this level due to a rapid population decline. Even with 90% defoliation trees are able to produce a near normal bud compliment on good sites. Damage is of such short duration most trees should recover. Another year of high population in these areas would probably cause substantial mortality. Unfortunately, there is no known way to predetermine the persistence of the outbreak in an area. After 3 years of looper outbreak in Maine it is apparent the outbreak on any particular stand will be brief. To date, none of the areas infested by looper in Maine have experienced heavy defoliation for more than 3 years. Most areas subside after 2 years, and many have only sustained one year of heavy damage.

Other factors that may influence the impact of looper are the hemlock borer and shoestring root rot. While the hemlock borer has not yet been linked to looper stressed hemlock in Maine, it may be a problem in the future. Shoestring root rot has been a problem in some stands, but it may take several years to manifest itself following looper related stress. The full significance of this pathogen is yet to be determined in Maine.

Fir and Spruce. Less is known about the ultimate impact of looper on fir and spruce in Maine. To date, looper populations seem to persist on fir and spruce stands and damage continues to accumulate. Some of the first stands of fir and spruce attacked by looper have experienced widespread mortality. Further study will be needed to determine if looper will cause significant fir and spruce mortality in Maine. Impact plots were established in fir and spruce areas in 1991.

Christmas Trees and Wreath Brush. Hemlock looper may also have a significant impact on the balsam fir Christmas tree and wreath industries in Maine. A survey of wreath producers and tippers in 1991 showed that some areas were damaged to a point where tips were unacceptable. However, fir

damage in 1991 was so spotty that tips could be cut elsewhere and therefore the impact was minor. If populations spread and intensify as the egg survey indicates the impact in 1992 could be much greater.

Very few fir Christmas tree growers had to spray to control looper in 1991, but this number may increase in 1992. Looper can severely damage crop trees if populations are high but they can be controlled with registered chemicals such as Diazinon.

Other Species. Hemlock looper causes noticeable feeding on several other tree species, but impacts seem minor. Extreme looper populations have caused 30 to 50% defoliation on yellow and white birch trees in predominantly spruce-fir stands on coastal islands. Damage occurred so late in the season that leaf drop had already begun. Other species associated with spruce-fir stands that have been noticeably defoliated include cedar, red spruce, and white pine.

Hemlock Looper Management Activities

Both commercial and small private landowners, affected by the current looper outbreak, have been very active in management of this pest to reduce losses. Most commercial landowners have attempted to reduce losses by salvage cutting and adjusting cutting plans. Large landowners have first selected the worst of their infested land by examining MFS or their own aerial defoliation maps, and the MFS general egg density survey. Based on these data and company cutting plans landowners have selected stands where specific population and damage samples are necessary to refine their looper management strategy. Industry staff have collected looper egg and damage samples that are examined and evaluated by the MFS. Landowners have used these evaluations to shift normal harvesting or salvage cuts to areas where looper represents a significant threat to the forest.

Commercial landowners have generally not given serious consideration to large scale spraying to reduce the impact of looper. Most of the commercial stands impacted by looper are hemlock stands and hemlock is not a particularly high value species. Also, hemlock in Maine usually grows as a minor component in mixed stands and stands of pure hemlock are usually small. Based on wood value alone, the cost of looper spraying would probably exceed benefits derived from the treatment especially if cutting is an alternative.

Control of looper damage by spraying has been employed successfully by several owners of residential or recreational property. Generally these private owners are primarily concerned by the effect of looper caused mortality on property values and aesthetics. Several property owners in coastal Maine and others with lots on inland lakes are planning spray operations in 1992. Because most affected residential properties are near people and water, the biological agent B.t. (Bacillus thuringiensis) is recommended for these treatments. Properly timed and executed B.t. spray treatments proved successful in 1991. Individuals considering spraying are generally dependent on the MFS for survey information, data evaluation, and spray timing.

Another important aspect of looper management on residential land is the removal of trees killed by looper. On many properties, especially on coastal islands, these dead trees represent a significant fire hazard. Removal of looper killed trees can be expensive to landowners.

Some owners of looper infested forest will decide to do nothing to lessen impacts. Considering the unpredictable and spotty nature of looper mortality, some of those who choose not to attempt to manage impacts will be successful.

Future Plans

A hemlock looper infestation of significant size is likely to continue in Maine for at least 2 more years and may persist in some fir and spruce areas much longer. MFS surveys and evaluation of the looper populations, damage, and impacts will continue until the outbreak subsides. Technical assistance will be provided to affected industrial and private landowners. Processing and evaluating egg and damage samples collected by industry foresters should be completed by March and recommendation on management options will be forwarded to the various companies. The MFS will also assist individuals and groups in planning, timing, and implementing spray projects in June of 1992.

Egg density and resulting defoliation data gathered in 1990 and 1991 will be analyzed in order to improve population forecasting. This study was partially funded by a U. S. Forest Service focus funding grant. The results of the study and a report should be available by late March.

Impact studies on established plots and other selected damaged areas will continue. A status report on the first years measurements of 23 permanent impact plots will be available in the spring of 1992. This study was also supported by a Forest Service grant.

Finally, the MFS will continue to observe and evaluate all aspects of the current hemlock looper outbreak. This includes evaluation of biological observations made in Maine and other affected jurisdictions to better understand the outbreak. Also, the MFS plans to share technical advances made in Maine with other jurisdictions on request.

From: Maine Dept. of Conservation, Maine Forest Service
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